DESCRIPTION

OF

THE JOHNS HOPKINS HOSPITAL

PUBLICATIONS
OF THE
JOHNS HOPKINS HOSPITAL

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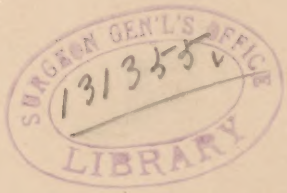
OF

THE JOHNS HOPKINS HOSPITAL

BY

JOHN S. BILLINGS, M. D.



BALTIMORE
1890

PRESS OF ISAAC FRIEDENWALD
BALTIMORE

MINUTE ADOPTED BY THE BOARD OF TRUSTEES OF THE JOHNS HOPKINS HOSPITAL, MAY 13, 1890.

"Dr. John S. Billings, the Medical Adviser to the President and Building Committee, presented to the Board the description of the Hospital which he had prepared, in compliance with the request made to him by the resolution heretofore passed to that end. In adopting it as a full and accurate account of the methods of construction of the Hospital, the arrangement of the wards and service buildings, and the system of heating, ventilation, plumbing, water supply and drainage, the Board desires to acknowledge and record that whatever excellence the institution can claim as an advance in hospital construction is due to the great and deserved eminence in medical and sanitary science of Dr. Billings, and his familiar knowledge of hospital relief of suffering, obtained through his Governmental service in that department in the late war; his extensive and discerning research in what has been done elsewhere, and his aptitude in appreciating, perfecting and constructing all appliances for the proper nursing and cure of disease in public institutions; and the watchful zeal with which he has directed every step from the beginning.

"For all this the Board hereby tenders to him its thanks for the results which are embodied in the book now submitted and approved."

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INTRODUCTORY

WASHINGTON, D. C., *January* 1, 1890.

FRANCIS T. KING, ESQ.,

President of the Board of Trustees, The Johns Hopkins Hospital.

Dear Sir:—In accordance with a request to that effect from the Board of Trustees, I have the honor to present herewith a description of the Johns Hopkins Hospital, with plans, sections, and other illustrations. The preparation of this work has brought vividly to mind the many conferences which we have had over the preliminary sketches and estimates and the finished drawings of which many of these are reproductions, and the gradual development of the ideas which are now embodied in the group of buildings, and the arrangement of the grounds which are here described.

Permit me to express my high appreciation of, and sincere thanks for, the honor of having been called upon by the Trustees to act as their medical adviser in this important work, and for the great courtesy and kindness with which my recommendations have uniformly been received and considered. The plans of these buildings embody the counsels and suggestions of many men and women, both in this country and abroad, but among them all there is no one who has had more to do with shaping the final results than yourself, and it is proper that this fact should be distinctly stated and recorded. In the preparation of this paper I am much indebted to Mr. W. H. Leeke, the Superintendent of Construction, and to Dr. Hurd, the present Superintendent of the Hospital, for data and suggestions, and to Mr. George Archer for the very careful drawings from which the illustrations have been prepared.

Hoping, and believing, that the work of this Hospital in relieving suffering and preventing death, in educating physicians and nurses, and in increasing knowledge, will in the future more than justify the labor and money expended upon its construction,

I remain, with great respect,

Yours very sincerely,

JOHN S. BILLINGS.

LETTER OF JOHNS HOPKINS TO THE TRUSTEES.

BALTIMORE, *March* 10, 1873.

To FRANCIS T. KING, *President*, and JOHN W. GARRETT, Hon. GEORGE W. DOBBIN, GALLOWAY CHESTON, THOMAS M. SMITH, WILLIAM HOPKINS, RICHARD M. JANNEY, JOSEPH MERREFIELD, FRANCIS WHITE, LEWIS N. HOPKINS, ALAN P. SMITH, and CHARLES J. M. GWINN, *Trustees of "The Johns Hopkins Hospital."*

Gentlemen:—I have given you, in your capacity of Trustees, thirteen acres of land, situated in the city of Baltimore, and bounded by Wolfe, Monument, Broadway and Jefferson streets, upon which I desire you to erect a Hospital.

It will be necessary to devote the present year to the grading of the surface, to its proper drainage, to the laying out of the grounds, and to the most careful and deliberate choice of a plan for the erection and arrangement of the buildings.

It is my wish that the plan thus chosen shall be one which will permit symmetrical additions to the buildings which will be first constructed, in order that you may ultimately be able to receive four hundred patients; and that it shall provide for a Hospital, which shall, in construction and arrangement, compare favorably with any other institution of like character in this country or in Europe.

It will, therefore, be your duty to obtain the advice and assistance of those, at home and abroad, who have achieved the greatest success in the construction and management of Hospitals.

I cannot press this injunction too strongly upon you, because the usefulness of this charity will greatly depend upon the plan which you may adopt for the construction and arrangement of the buildings. It is my desire that you should complete this portion of your labor during the current year, and be in readiness to commence the building of the Hospital in the spring of 1874.

It will be your duty, hereafter, to provide for the erection, upon other ground, of suitable buildings for the reception, maintenance and education of orphan colored children.

I direct you to provide accommodation for three or four hundred children of this class; and you are also authorized to receive into this asylum, at your discretion, as belonging to such class, colored children who have lost one parent only, and, in exceptional cases, to receive colored children who are not orphans, but who may be in such circumstances as to require the aid of the charity.

I desire that you shall apply the yearly sum of twenty thousand dollars, or so much thereof as may be necessary of the revenue of the property which you will hereafter receive, to the maintenance of the Orphan's Home intended for such children.

In order to enable you to carry my wishes into full effect, I will now and in each succeeding year during my life, until the Hospital buildings are fully completed, and in readiness to receive patients, place at your disposal the sum of one hundred thousand dollars.

In addition to the gift, already made to you, of the thirteen acres of land in the city of Baltimore, upon which the Hospital will be built, I have dedicated to its support and to the payment of the annual sum provided to be paid for the support of the Orphan's Home, property which you may safely estimate as worth, to-day,

two millions of dollars, and from which your corporation will certainly receive a yearly revenue of one hundred and twenty thousand dollars; and which time and your diligent care will make more largely productive.

If the Hospital and Orphan's Home are not built at my death, it will be your duty to apply the income arising from the property so dedicated, to their completion. When they are built, the income from that property will suffice for their maintenance.

The indigent sick of this city and its environs, without regard to sex, age, or color, who may require surgical or medical treatment, and who can be received into the Hospital without peril to the other inmates, and the poor of this city and State, of all races, who are stricken down by any casualty, shall be received into the Hospital, without charge, for such periods of time and under such regulations as you may prescribe. It shall be your duty to make such division of the sexes and patients among the several wards of the Hospital as will best promote the actual usefulness of the charity.

You will also provide for the reception of a limited number of patients who are able to make compensation for the room and attention they may require. The money received from such persons will enable you to appropriate a larger sum for the relief of the sufferings of that class which I direct you to admit free of charge; and you will thus be enabled to afford to strangers, and to those of your own people who have no friends or relations to care for them in sickness, and who are not objects of charity, the advantages of careful and skilful treatment.

It will be your special duty to secure for the service of the Hospital surgeons and physicians of the highest character and greatest skill.

I desire you to establish in connection with the Hospital a training school for female nurses. This provision will secure the services of women competent to care for the sick in the Hospital wards, and will enable you to benefit the whole community by supplying it with a class of trained and experienced nurses.

I wish the large grounds surrounding the Hospital buildings to be properly enclosed by iron railings, and to be so laid out and planted with trees and flowers as to afford solace to the sick and be an ornament to the section of the city in which the grounds are located.

I desire that you should in due season provide for a site and buildings, of such description and at such distance from the city as your judgment shall approve, for the reception of convalescent patients. You will be able in this way to hasten the recovery of the sick, and to have always room in the main Hospital buildings for other sick persons requiring immediate medical or surgical treatment.

It is my especial request that the influence of religion should be felt in and impressed upon the whole management of the Hospital; but I desire, nevertheless, that the administration of the charity shall be undisturbed by sectarian influence, discipline or control.

In all your arrangements in relation to this Hospital, you will bear constantly in mind that it is my wish and purpose that the institution shall ultimately form a part of the Medical School of that University for which I have made ample provision by my will.

I have felt it to be my duty to bring these subjects to your particular attention, knowing that you will conform to the wishes which I thus definitely express.

In other particulars I leave your Board to the exercise of its discretion, believing that your good judgment and experience in life will enable you to make this charity a substantial benefit to the community.

I am, very respectfully, your friend,

JOHNS HOPKINS.

After careful consideration of the various questions arising under the will and letter of instructions, the Trustees authorized their Building Committee to confer with five physicians, chosen from different parts of the country, who had made hospitals their study, and to obtain from them advice. This was done in the early part of 1875, the physicians selected being Dr. Norton Folsom, of Boston; Dr. Stephen Smith, of New York; Dr. Caspar Morris, of Philadelphia; Dr. Joseph Jones, of New Orleans; and Dr. John S. Billings, of the United States Army; to each of whom a letter was sent, of which the following is a copy:

OFFICE OF THE JOHNS HOPKINS HOSPITAL,

BALTIMORE, *March* 6, 1875.

Dear Sir:—The late Johns Hopkins, a rich citizen of Baltimore, bequeathed to trustees a munificent foundation for the building and support of a hospital, mainly intended for the benefit of the indigent sick of the city of Baltimore and its environs.

The letter which, some time before his death, he addressed to his trustees will best describe the object he had in view, and a copy of it accompanies this communication.

The execution of this munificent charitable purpose has been entrusted to a body of trustees, none of whom, with a single exception, belong to the medical profession, and, apart from the injunction which the founder's letter imposes upon them, "to obtain the advice and assistance of those, at home and abroad, who have achieved the greatest success in the construction and management of hospitals," they would have distrusted their own ability to cope with a subject so strictly scientific and professional, without first resorting to the best sources of information within their reach.

To this end the Board of Trustees has authorized their Building Committee "to confer with five distinguished physicians, chosen from different parts of the country, who have made hospitals their study, and obtain from them such advice as they may need, and to compensate them for it." It is in execution of the authority thus conferred that this communication is addressed to you, and you are invited to make such response to it as your fulness of information, stimulated by the importance to humanity of the subject, may prompt you to.

Besides the information afforded by the letter, some additions are needful to be made, and some corrections which altered circumstances require.

You will observe that the site of the proposed building is there designated; and, as we assume that you are not acquainted with it, it is proper to add that it consists of an eligible piece of ground situated in the eastern part of the city; that it is fourteen acres in extent, in the form of a parallelogram, 709x856 feet; that it is very elevated above the general level of the city, and commands an extensive view in all directions; that it is healthy, with complete surface drainage, whilst underground drainage may be accom-

plished to tide-water; and that it is easily accessible by street railway and by paved streets, which bound the four sides of it.

It is also proper to state that the endowment, which in the letter is spoken of as amounting to two millions of dollars, is now, by subsequent additions made to it by the founder, at least three millions of dollars, yielding an annual revenue of $180,000.

Out of this income, the Hospital building proper, an establishment for convalescent patients, and a home for colored orphans are to be erected, after which the income will be applied to their support, as indicated in the letter. The means thus available we believe will be ample to execute the trust with as much speed as a due regard for doing it carefully will justify.

You should also be told more fully than is done in the letter, that the founder of the Hospital, by his will, provided for the establishment of a University, upon a site also devised by him, distant about a mile from the Hospital. To the uses of this institution he has also dedicated over three millions of dollars of his fortune, and he looked to the Hospital as furnishing a most desirable aid to medical education in the University.

These preliminary statements are made in order that you may have a full view of the subject about which we now seek your advice.

It will readily occur to you that the subject most prominent at this day, in the professional consideration of the hospital question as applicable to cities, is the choice between the *pavilion* system, which admits buildings of two or more stories in height permanently constructed, of which the Herbert Hospital in England and several in this country may be considered good modern types; and the *barracks* system of one-story structures, destructible in whole

or in part, which were so successfully used in the late war, but of which no extensive and prominent example is now in operation. In determining the claims of these systems respectively, as applicable to us, careful regard should be had to the character of patients intended to be the subjects of our nursing, so as to avoid the error of building an institution which shall prove not to meet the requirements demanded in the care and cure of women and children, and the generally enfeebled inhabitants of the sheltered lanes and alleys, however much such a structure may have been a success when applied to the uses of hardy men in the field.

We presume there must be some general principles of hospital hygiene and of hospital treatment fixed and immutable in their character, the discovery and proof of which are the result of close, careful recorded observation and judgment. If these principles can be best applied through the agency of the pavilion system, we wish to adopt that; if by the barrack system, then we will avail ourselves of that form of construction; and if the true rule for our guidance shall be found in the selection of the good features of each, and the combining of them all into a harmonious middle course, then we desire to make that selection and combination.

In whatever plan may be adopted, we presume there will be no departure from the now very general method of a central administration building, with wards for the treatment of the sick as carefully separated therefrom and from each other as practicable. To the details of this building we especially invite your attention, the objects to be accommodated in it, the amount of room to be given to each, and their location with respect to each other for convenience and use.

Comprehended within these details will be the consideration of

the accommodations needed for the training school for nurses, and whether they should be within the hospital building or separated from it; and as the Hospital will be used for clinical teaching to the medical classes of the University, it will be needful to consider what accommodations that subject will require, and how and where they should be provided.

As closely connected therewith, we should be glad to have your advice as to the most judicious location of the medical school buildings of the University; that is, whether they should be in close proximity to the Hospital or whether they can, with equal profit and convenience, be erected with the other buildings of the University, a mile distant.

In the same general category of things to be provided would be included suitable appliances for promptly and efficiently caring for accident cases, so numerous in a large city, and a dispensary for out-of-door relief, both by the dispensing of medicines and the giving of medical advice.

In the treatment of these subjects, it is not to be expected that you will present architectural drawings, but if your views can be illustrated by such suggestive sketches as your pen or pencil can throw off in aid of your thoughts, they will be gratefully received, and placed in the hands of our architect for more elaborate expression.

Certainly not second in importance to any of the matters you are invited to instruct us upon, are those of ventilation and heating, and the kindred subjects of light and sunshine, as curative agents. The various methods of heating, combined with ventilation, form professional problems about which the most experienced and best informed medical minds seem to be far from being united. Whether

heating should be accomplished by steam or hot water pipes radiating their heat directly into the room, or by the same agency imparting heat to air in chambers, to be thence sent into the apartments to be warmed; or by open fires in the angles or side walls; or by ventilating stoves in the centre of the ward, or by a combination of these methods, are subjects upon which opinions widely differ;—and whether *ventilation* should be accomplished by what is called the natural method, through doors, windows, and unavoidable leakages, or through flues and ducts acted upon by the differing temperature of the outer and inner air, or by enforced currents set in motion by fans, blowers, or other mechanical contrivances, are points which have equally learned advocates and opponents. To solve for ourselves these difficult problems, we invoke the aid of your experience and thoughtful judgment.

The location of the kitchen and its appurtenant offices is a subject of great practical importance upon which new and, so far as we know, hitherto untried suggestions have been made. Whether it should be in a separate building from those devoted to administration or to the nursing and care of patients, or in the basement of some one of them, or in the upper story of any, are points open to discussion and to be carefully considered.

Upon the subject of *management*, with its numerous details of medical attendance, resident and occasional, nursing, domestic advice, and, indeed, with reference to the whole matter, our wish is to put you in our place so far as to learn from you how you would execute the trust we are now seeking to be instructed about, if it were confided to you.

We beg you to consider what has been said as mere suggestions of some of the topics to be considered, and not as limitations either

upon the subjects to be treated or upon your mode of treating them, and we ask your zealous co-operation in this humane subject, to which it is understood you have given great attention.

It is right that you should also know that, besides the request now made to you, a copy of this letter has been addressed to four other distinguished members of your profession, whose communications in reply, together with yours, will be printed in a volume for our private use, and for such useful distribution as so valuable a contribution to medical literature will be well entitled to.

It only remains for us to add that, if you will kindly serve us and the cause of suffering humanity in the way we have indicated, we shall hope to receive your paper by the first of May.

Please acknowledge the receipt of this, and oblige,

Very respectfully yours, etc.,

FRANCIS T. KING,
President of Board of Trustees.

ADDRESS DELIVERED AT THE OPENING OF THE HOSPITAL, MAY 7, 1889.

By Francis T. King,

President of the Board of Trustees.

It is my pleasant duty, in behalf of the Trustees of the Johns Hopkins Hospital, to offer you a cordial welcome, and to express our high appreciation of the interest in our work which is manifested by your presence here to-day.

It cannot be a matter of small or temporary importance that brings to this opening the chief executives of our State and our City, so many of our distinguished men in all branches of the public service, so many well-known professional men from distant cities and countries, and so many of our own most prominent and public-spirited citizens; and it gives us a renewed sense of our responsibilities and duties to find that we are to give an account of what we have done in the past and what we hope to do in the future to such an audience as we see before and around us.

It encourages us to hope and believe that the trust which has been confided to us is one not only of local but of national and even of international importance, and we have abundant evidence in the many letters which have come to us from beyond the sea, that the opening of this Hospital and the commencement of its philanthropic, educational and scientific work, is a matter which interests many men and women in Europe as well as in all parts of this country.

Johns Hopkins did not leave a hospital; what he did leave was a complicated piece of machinery in the form of various investments

capable of evolving the power required to construct and maintain a hospital, for in this sense money is power. This machinery requires constant adjustment and looking after, and for this part of the work the Trustees are solely responsible.

When I tell you that these seventeen buildings have been constructed and furnished, and these fourteen and a half acres enclosed and beautified as you see them to-day, not only without taking a dollar from the principal placed in the hands of the Trustees, but with an actual increase of the endowment by judicious investments by the sum of one hundred and thirteen thousand dollars, I think it may be justly claimed that the Trustees have not failed in this part of their duty.

The speakers who are to follow me will tell you of the plans of the Hospital, of the objects which have been kept in view in the preparation of the methods adopted to secure the best possible conditions for the treatment of the sick and wounded who come to it, of its relations to medical education, to improvement of the science and art of medicine, and to the other great trust of Johns Hopkins with which it is so intimately connected—namely, the University.

I will therefore devote my closing remarks to one or two personal reminiscences of the man to whom we owe the magnificent possibilities of his two great gifts.

I need not speak of the birth, education and business career of Johns Hopkins, with which most of you are familiar, as he was a native of this State.

What were the motives which led him to found his two great trusts, each with an endowment of nearly three millions and a half of dollars? Was it the act of a man of great wealth without

children, who, near the close of life, wished to build a monument to his memory? No, not at all; it was done conscientiously, with all the deliberation, judgment and grasp of subjects which characterized him through life, first as a successful merchant, then as a banker.

I remember, many years ago, while spending an evening at Clifton, I heard Johns Hopkins say, in reply to a question put to him by an intimate friend of his own age, why he had never made a will, that he looked upon his wealth as a gift, for which he was accountable; that it grew and piled up from a small beginning, he hardly knew how; but he was sure it was given to him for a purpose, and he did not believe he would die before he was given to see how he should dispose of his estate. "This wealth," he repeated, "is my stewardship."

Again, when his Trustees arranged to visit the hospitals of Philadelphia, New York and Boston, he was asked to accompany them; his reply was, "You surely do not want to parade me around the country. I would not for a moment think of going; it would be in very bad taste, to say the least of it. I have carefully chosen my Trustees, and have committed everything to them. I will furnish the means, and they must build the Hospital."

Johns Hopkins purchased this site himself, which then consisted of the grounds of the Maryland Insane Asylum, two large lots and seventeen dwellings, in all fourteen and a half acres of ground, in an improved portion of the city, closing two public streets, thus at once determining the magnitude and character of his Hospital.

Let Johns Hopkins again speak for himself in the words of his letter to his trustees, which show the wide scope of his interest in all conditions of mankind:

"You shall receive into the Hospital the indigent sick of this city

and its environs, without regard to sex, age or color, who may require surgical or medical treatment, and the poor of this City and State, of all races, who are stricken down by any casualty.

"You will also provide for patients who are able to make compensation for the room and attention they may require, and thus be enabled to afford to strangers and to those of our own people who have no friends or relatives to care for them in sickness, and who are not objects of charity, the advantages of careful and skilful treatment.

"It will be your duty hereafter to provide for the erection, upon other ground, of suitable buildings for the reception, maintenance and education of orphan colored children, for which purpose I desire that you shall apply the yearly sum of twenty thousand dollars, or so much thereof as may be necessary."

I wish to say, on behalf of the Trustees, a few words of recognition to all who have labored to bring these plans to their conclusion; to the medical adviser, whose invaluable services have covered more than ten years; to the President of the University, who has so ably aided in organizing; to the architects and builders, and to those who have had but occasional opportunities to serve us, but who have freely contributed their wisdom and experience whenever called upon, and especially to the physicians and surgeons, the managers of other hospitals, the superintendents of training schools for nurses, and to many others, at home and abroad, whose kind co-operation has been most serviceable.

Many of these friends are within the sound of my voice, others far away; none are forgotten; not a few sent us letters which show their lively interest in this occasion.

As Johns Hopkins was brought up by godly parents—members

of the Society of Friends—I should have been glad if we might have heard the voice of Whittier, the Quaker poet, but in the letter which I hold in my hand he pleads his age and illness as an excuse for his silence. He expresses his pleasure in seeing that the wise and benevolent design of the founder has been so well carried out, and his hope that the example of Johns Hopkins will not be lost upon his country.

To the words of his letter I will venture to add this verse, which he wrote for another occasion, but which is equally appropriate to this:—

"Not vainly the gift of its founder was made;
Not prayerless the stones of its corner were laid;
To Him be the glory forever!—we bear
To the Lord of the harvest our wheat with the tare;
What we lack in our work, may He find in our will,
And winnow in mercy our good from the ill!"

ADDRESS, DELIVERED AT THE OPENING OF THE HOSPITAL, MAY 7, 1889, ON THE PLANS AND PURPOSES OF THE JOHNS HOPKINS HOSPITAL.

By John S. Billings, M. D.,

Surgeon, U. S. Army.

The third paragraph of the letter of instructions communicated by Johns Hopkins to the trustees whom he had chosen to carry out his plans for a hospital in the city of Baltimore, states that "it is my wish that the plan . . . shall provide for a Hospital which shall, in structure and arrangement, compare favorably with any other institution of like character in this country or in Europe." What do you suppose the writer was thinking of when he penned that sentence? Had he in view any definite ideal; any mental picture of the institution which he proposed to establish; or was it merely an expression of a desire to give to his city the best thing that could be devised? I have read that letter many times; have heard much of the ideas, hopes and wishes which were expressed in the numerous conversations which preceded its preparation; and it seems to me that the writer had an ideal, and not a mere vague desire—an ideal which was no doubt somewhat misty, but which did not correspond to any existing hospital, and one which he did not attempt to define except in a few prominent points, to which I shall presently refer. In most respects Johns Hopkins took the same course with his Hospital which he did with his University, and deliberately refused to trammel with specific directions those whom he had chosen to carry out his plans; but this letter of instructions

indicates, nevertheless, a conception of much more definite character, and one which had been the subject of more discussion and reflection than his scheme for a University. Whether this be so or not, I am at all events sure that his trustees have endeavored to comply with this letter of instructions, and to do so in the broadest and best sense of the words.

The beginning of the results we have before us to-day—results which even now are not confined to these particular aggregations of bricks and mortar, as will be presently explained, and the end of which will be, as we hope and believe, to make life happier for millions now living and yet unborn. Only those who took part in the early deliberations of those charged with this trust can fully realize the anxieties, the doubts, the manifold perplexities which at first attended their decisions and movements. Only one or two of them had any knowledge of hospital matters; most of them were business men, bankers, lawyers, judges, railway managers, men who knew something of the management of men and money, but who were now brought face to face with a new problem—viz., how to build, organize and manage a hospital so that it should compare favorably with any other hospital in this country or in Europe.

To "compare favorably with"—what does that mean? It is a peculiar phrase, which, coming from a shrewd business man and a member of the Society of Friends, signifies, I think, to excel, if possible; at all events, that is the safest interpretation. And it was not this or that hospital which was to be surpassed or equaled, but all other hospitals in this country or in Europe—Africa, Asia and Australasia being put out of the question. It was a large contract.

The location was fixed—that had been done by Johns Hopkins—but they had to decide whether the structures to be erected should

be temporary or permanent; of wood, brick, or marble; in one large building or in many; and many other like points, before even the preparation of plans could be commenced. They followed the instructions of the donor and got advice, of which a great abundance was available. They visited the large hospitals of our Eastern cities, employed five men, supposed to be skilled in hospitals, each to write an essay giving his plans and suggestions, published these essays in a book which had a wide circulation, and studied the criticisms and reviews to which this book gave rise.

Having duly considered the multifarious and widely divergent suggestions thus obtained, they finally selected one of the essay writers, and asked him if he was satisfied with his own plans, now that he had seen the others and the published criticisms upon them. He promptly said that he was not, whereupon they asked him to try again and do better. He set to work, aided by the architect of the Board, and the result was a set of sketch plans which he took abroad and upon which he obtained much counsel and criticism, examining at the same time the model hospitals of Europe. He was much less satisfied with the sketch plans when he came back than he was when he started, and again the building committee, the architect, and himself reviewed the whole matter, and finally settled on the general arrangement which you will see to-day. Many details remained to be worked out; even the façades had not yet been designed; but the general scheme was settled, and the rest was comparatively easy for the time being.

Let us now for a few moments consider the broad general principles which governed the trustees in the adoption of this plan. The first hospitals were established to give shelter and food to the sick poor, especially those who gathered in cities. Gradually

physicians found that they could learn much in these aggregations of suffering, and that they afforded the means of teaching others; but this last use of them is only about two hundred years old. Gradually, also, it came to be known that the knowledge thus obtained in the care of the sick poor was of use in treating the diseases of the well-to-do; and finally, within the last twenty-five years or so, people are beginning to find out that when they are afflicted with certain forms of disease or injury they can be better treated in a properly appointed hospital than they can be in their own homes, no matter how costly or luxurious these may be. In the hospital they can have not only all the comforts of home, but more; not only skilled medical attendance and skilled nursing, but the use of many appliances and arrangements specially devised for the comfort and welfare of the sick which can hardly be found in any private house, and also freedom from noise and many petty annoyances, including in some cases too much sympathy and in others too little. This Hospital, then, is to provide for the rich as well as for the poor; for those who can, and who ought to, pay for the help given, as well as for those who cannot.

A second cardinal principle to be observed in such a hospital as this, is that it shall do as little harm as possible. A hospital may do harm by its foul air, by spreading contagious disease among its inmates, by neglect or carelessness of its nurses or attendants; and in years gone by hospitals have, no doubt, caused nearly as much sickness as they have relieved. This is now rarely the case, and in this hospital the arrangements for ventilation, isolation, and nursing are such as to entirely do away with this danger. There is another danger connected with free hospitals and dispensaries which is of quite a different kind, and to which I can here only

allude; namely, the danger of promoting negligence, shiftlessness, laziness, and vice by offering free relief from their consequences—the danger of pauperizing people. This is a danger connected with organization and management rather than with construction, and I can only say here that it has been foreseen; and will be, as far as possible, guarded against.

The third principle to be kept in view in such a hospital as this, is that it should provide the means of giving medical instruction; for the sake of the sick in the institution as well as of those out of it. It is well known to those familiar with the subject that the sick in a hospital where medical instruction is given receive more constant, careful, and thoughtful attention than do those in a hospital where no such instruction is given. The clinical teacher must do his best; keen eyes will note every error in diagnosis, every failure in results of treatment. Moreover, the very act of teaching clarifies and crystallizes his own knowledge; in attempting to explain, the dark places become prominent and demand investigation; and hence it is that those cases which are lectured on receive the best treatment. I need say nothing here on the other side of the question, the value of properly trained physicians to the community and the necessity for hospital instruction in such training; Johns Hopkins understood all this and specially directed that "in all your arrangements in relation to this Hospital, you will bear constantly in mind that it is my wish and purpose that the institution shall ultimately form a part of the Medical School of the University."

Now, there are medical schools and medical schools, and in obeying this direction of the donor the trustees had to consider what sort of a medical school this school of the University was likely to be. As the majority of the trustees were also trustees of

the University, they knew well the principles which underlie the organization of that institution, and that the same principles would govern the organization of the medical department, when that came to be taken in hand. One of these principles is the thorough teaching of that which is known; another is to increase that which is known, and to furnish the men and means for doing this. So also the Hospital should not only teach the best methods of caring for the sick now known, but aim to increase knowledge, and thus benefit the whole world by its diffusion. Another point which had to be kept in view was the direction of Mr. Hopkins that there should be established, "in connection with the hospital, a training school for female nurses, not only to care for the sick in the hospital, but to benefit the whole community, by supplying it with a class of trained and experienced nurses."

It is also highly desirable that a hospital of this kind should have connected with it a well-appointed dispensary for the treatment of those who need medical aid, but not a bed in the hospital. Through such a dispensary much good can be done at small cost, the selection of proper patients for the hospital is facilitated, the means of medical investigation and teaching are greatly extended, and the scope of the nursing system can be made to reach the poor and ignorant in their own homes.

The last point to which I shall refer, which was kept in view by the trustees in deciding upon the plans, was the general appearance of the buildings and grounds.

Mr. Hopkins gave no specific directions as to the buildings, but he directed that the grounds should be properly enclosed by iron railings, and so laid out and planted as to be a solace to the sick and an ornament to the city, and it was evident that the buildings

should be of the same character, so far as their purpose would admit. It was therefore decided that, while no utility should be sacrificed for the sake of architectural ornament, and the main purpose which I have referred to should be fully worked out in the plans before any attention was paid to external appearance, it was fit and proper that the buildings should form an ornament to the city, and a suitable monument to the memory of the donor.

Bearing in mind, then, these main principles, to provide for the proper care of the sick, both rich and poor, to provide for the highest class of medical education, to increase and diffuse knowledge, to provide trained nurses for both hospital and city, to provide a dispensary, and to make the buildings and grounds ornamental and attractive, let us see how the problem has been thus far worked out.

I will begin with the arrangements for securing that article of prime necessity in a hospital—viz., pure air. Air supply and ventilation in this climate are inseparably connected with heating for a considerable portion of the year, for comfortable warmth must be secured, and on the means of doing this must largely depend the methods of ventilation and their success. The temperature of Baltimore may vary from 103° in the shade to 3° below zero F., hence its perfect hospital must be one which would answer for the tropics or for northern Russia. To secure this, double walls, with air spaces, were given to the buildings, and a system of heating by the circulation of hot water was adopted for the wards. This system consists of central boilers, from which flow and return pipes extending beneath every building, connected with heating coils, of which there is one for every two beds in the ward above. The temperature in these coils can be exactly regulated to any tempera-

ture between 150° F. and the temperature of the external air by simply regulating the velocity of the flow of water by the valves attached to each coil, and thus it is quite possible to give one pair of beds a temperature of 70° and another pair in the same room, at a little distance, a temperature of 60° F., to suit the needs of different cases. The 80,000 gallons of water contained in this heating apparatus go round and round, carrying heat from the furnaces to the wards; but every building has its own independent means of ventilation, and it is not possible to go from one ward into another without going into the open air on the way, so that foul air, if any forms, cannot spread from one building to another. Nevertheless, the buildings are so connected by corridors and underground tunnels that in passing from one to another there is no exposure to rain or snow, and the least possible to cold air, while the food is not exposed at all. This is not the place to describe the ventilation. I will only call your attention to the fact that the temperature of the incoming air by any bed is easily changed by turning a valve, while the quantity of air is not changed; to the arrangement for taking foul air from either the bottom or top of the ward, or from both, and to the fact that all this has been thoroughly tested during two winters and found to give the results hoped for.

One of the peculiarities of the wards is that all the service rooms are collected at the north end, leaving the south end free of obstruction and fully exposed to the sun, the end of the ward being a large bay window looking out on the central garden, and with a floor which can be warmed, so that the patients able to sit there can be thoroughly comfortable. Another peculiarity of the sick wards is the arrangement for easy cleansing, and to prevent possible accumulations of dust in corners and crevices. Corners are to a great

extent done away with, and easy curves given in their place; even at the junction of the floor and walls there is a curve instead of the usual right angle, and I advise you to look at it and see how it has been produced, for it ought to become fashionable, and take the place of the old mop-board in all well-constructed houses. So, also, the doors have not the usual moulding about the panels, giving recesses which it is almost impossible to clean.

One of the wards is especially arranged for cases which may be either contagious or offensive. In this building each patient is in a room by himself, and all these rooms open into a corridor through which the wind is always blowing. There are many details about this isolating ward which are worth looking at, but which I have not time now to refer to, and I must omit details about the pay ward, the octagon ward, and the peculiar fittings and conveniences of the kitchen, laundry, apothecaries' building, etc., for the same reason.

Let us pass now to the second object of the Hospital, the giving means for higher medical education, and see what has been done for that. In the first place, there is a large amphitheatre with appended rooms for the reception of accidents and emergencies of all kinds. It the second place, provision is made for at least thirty students to reside constantly in the hospital to devote themselves, under proper guidance, to the study of disease and the practical care of the sick. It is intended that these places shall be open only to those who have had a thorough previous training, and who have shown themselves to be fitted to undertake this important part of their studies. As a rule not more than five per cent. of medical graduates have had any opportunities worth speaking of to study and treat diseases in the living man when they receive their diplo-

mas. They have to get this experience on their first patients, and sometimes the experience is rather hard—for both doctor and patient. This Hospital has provided for the class of the medical school in the last year of their studies good rooms with bath-rooms, a dining-room, and other conveniences, and here they can be taught the actual daily work of a physician, for which all their previous studies are only preparatory. Many of the arrangements of the Hospital have been constructed with reference to this instruction; it is a great laboratory for teaching the practical applications of the laws of hygiene to heating, ventilation, house-drainage, and other sanitary matters. All pipes and traps are either exposed to view or can be seen by merely opening a door, and in the tunnel beneath the corridor you can study at your leisure the complicated and yet simple arrangement of pipes for gas, steam, water, sewage, etc., which are usually buried and remain a profound mystery to every one except the plumber, and often puzzle even him.

Closely connected with this subject of teaching is that of increasing our knowledge of the causes, symptoms, results, and treatment of disease; in fact, one cannot be thoroughly and well done without the other, and hence many of the provisions for the one are also useful for the other. For example, to go back to our system of heating and ventilation, there are many points connected with it which are destined for experimental work—to compare steam with hot-water heating, to determine the velocity of water at different temperatures, to compare ventilation by aspiration with that by propulsion, or by upward currents with those drawn downward.

One structure is very largely devoted to and fitted for experimental research, and that is the pathological laboratory, where the causes, processes, and results of disease are to be studied. Upon

the results obtained in that laboratory may yet depend the saving of many lives, the relief of unspeakable agony, the warding off of pestilence from the city, and, to put it in a strictly business light, the value of real estate and the rate of taxation of this community. We are on the verge of great advances in our knowledge of the causes and methods of disease, and I feel sure that these will be only preliminary steps to far greater and better knowledge of how to prevent or to treat them than we now have. The probable length of life of the new-born infant to-day is not much more than half what it ought to be; the practical productive period of the life of our men and women is shortened and interrupted by unnecessary disease and suffering; but remember, if these things are to be amended, it is not merely by teaching old doctrines—we must open fresh windows and let in more light, so that we can see what these obstacles really are. It is in this work of discovery that it is hoped that this Hospital will join hands with the University, and it is in this hope that some of the structures around you have been planned and provided.

A word now on the fourth object kept in view in this Hospital—viz., the training school for nurses.

Some of you probably have had some personal experience of the difference between an educated, properly trained female nurse, and one of the old-fashioned sort; but if you have not, it would take much more time than I now have to describe it. I can only say that in many cases a competent trained nurse is as important to the success of treatment as a competent doctor, and that one of the greatest difficulties in treating well-to-do patients in their own homes in this city is the want of proper nurses. Affection and zeal may do much, but they cannot take the place of knowledge, and this kind of knowl-

edge is not to be acquired in a day or in a month. It is a work best carried out by women, though not one woman in ten is fit for it, or should undertake it. But the woman who is fit for it, who has physical health and strength, sound sense, loving kindness, patience and tact, and who has been thoroughly taught the art of nursing the sick, with all its thousand details, has the power of doing good and increasing happiness to a degree which few others possess. In a properly conducted hospital ward she is a necessity, but her field of usefulness and helpfulness is by no means limited to that. She is needed outside the hospital—in the home of the rich, to nurse and care for the sick; in the home of the poor, to teach prevention as well as nursing. To gather here such women, to have them thoroughly instructed, to furnish them with the attractive and comfortable home which they deserve, and to send them where they are most needed, with provision for their return when the work is done, is the object of the training school of this Hospital.

For this purpose the trustees have provided a large and handsome building, separated from the others, and exclusively appropriated to the female nurses, where each can have her own comfortable room, and where a common parlor, library, dining-room, bath-rooms, and, in short, the arrangements of a first-class hotel, are provided for their use. Here also is a training-kitchen and a lecture-room to aid in the work of instruction. The intention is that when the nurse has finished her six or eight hours' tour of duty with the sick, she shall come quite away from the ward and all that pertains to it and take her rest and recreation in a totally different atmosphere, and special effort has been made to have this home attractive and pleasant.

The fifth object which I mentioned as having been kept in view in the plan and construction of these buildings is the dispensary. This is a large building on the north front, consisting of a large central waiting-room, surrounded by a number of smaller rooms for the use of the physicians and surgeons who are to examine and prescribe for the patients, and having bath-rooms, and a small apothecaries' establishment for the issue of the medicines ordered. This building is connected with the amphitheatre by a short covered corridor, and is specially arranged with reference to teaching. It, as well as the amphitheatre, is heated by steam instead of hot water, partly because they are not in constant use, and a rapid means of warming is desired, partly for the purpose already referred to of giving the means of experimental comparison of the two systems. The means of supply of fresh warm air in these two buildings, and of removing the air made impure by exhalations, are somewhat peculiar, and merit examination.

With regard to the architectural design and external appearance of the buildings, and the laying out and ornamentation of the grounds, I can only say that you must see and judge for yourselves whether Mr. Hopkins's wish that they should be an ornament to the city has been successfully complied with. So far as external ornamentation is concerned, it is confined almost entirely to the large buildings on the west, or Broadway, front, which it was felt should harmonize in style of decoration. These central buildings, consisting of the administration, with the one pay ward on either side, are constructed of pressed brick, with ornamentation of a dark blue, fine-grained, hard and durable stone, known as Cheat River stone, and of molded terra-cotta of the color of the brick. The external designs for these, as for all the other buildings, were fur-

nished by Messrs. Cabot and Chandler, of Boston, and I think we have good reason to be well satisfied with the results they have produced. The grounds are laid out and planted in accordance with designs furnished by Mr. E. W. Bowditch, of Boston.

As regards construction, I do not hesitate to affirm that these are the best built buildings of their kind in the world. The material is the best, the most skilled and careful workmen were employed, and, above all, the work received the most careful, conscientious, and intelligent supervision as it progressed. For this supervision we are indebted to Mr. John Marshall in the beginning and to Mr. William H. Leeke for the remainder and conclusion of the work; and we are also indebted to the latter for many valuable suggestions as to modes and details of finish, which are so important in a hospital. The details of the complicated and extended system of heating, ventilation and plumbing were designed and the work executed by Messrs. Bartlett, Hayward & Co., of this city. I should like to go on and mention the names of a number of other persons who have done good work here, but want of time forbids.

Briefly and incompletely as I have sketched these salient points of the plans and purposes of this Hospital, I hope I have, nevertheless, shown you that it is intended for other purposes besides providing shelter, food and drugs for the sick. In saying this I have not the least wish to undervalue or disparage those institutions which do make this their main or only object. There is abundant need of their existence and work also; but this institution should not be judged by the rules which apply to them; it cannot be managed after their fashion; if it does not produce results different from theirs, it is a failure and the expenditure upon it a mistake.

Thus far I have been speaking of the buildings only, and trying to give you some idea of the motives which led to their being as they are, and what they are, and not otherwise. From the beginning, however, it has been recognized that the buildings and machinery are only means to an end, tools which must be handled by skilled workmen to produce the desired result; and throughout all these years of planning and building, the question of organization and of the sort of men and women who were to use and work with these things has not been lost sight of. It is true that no attempts were made to select and engage individual members of the hospital staff until quite recently; but there was, nevertheless, a tolerably definite conception as to the ideas, mode of work, character and wants of those who are to constitute this staff, and when the time came for selecting, it was made by this standard.

On the philanthropic, social and religious aspects of this great trust I do not propose to touch, but I wish to say a very few words of the hopes and wishes of scientific men and physicians with regard to it. From the time of the first announcement of the Hopkins bequests to the present, these men, all over the world, have been keenly interested in the plans and methods adopted in carrying them out. Whenever and wherever the problems of higher medical education have been discussed within the last ten years, there has been speculation as to the probable course of the Johns Hopkins medical department, and the influence it would have upon the standard. I may even say that some of this influence has been exerted in advance—has been discounted, as it were—for the plans of this Hospital have stimulated changes in some of our best medical schools, and have been copied with more or less modification in some of our latest hospitals.

What is it, then, that the physicians want? Is it more physicians, more family practitioners, more surgeons, more specialists? Not at all. They know very well that there is no danger that the supply will not be equal to the demand; when they become overburdened with practice, they do not at present find it difficult to obtain assistants; they have no fear lest the seventy or eighty medical schools of this country should fail to produce a sufficient number of medical practitioners to meet the wants of our increasing population; and they know also that the medical schools of Great Britain and Germany are sending to us quite as much of their product as we can conveniently dispose of. They hope that the Hopkins medical school and Hospital will do two things. The first is, that it will demand of those who propose to become its students evidence that they have a sound basis of preliminary education before they commence, and that its standard in this respect shall be little below that of the requirements for granting the degree of bachelor of arts in the University. It is hoped that the men thus selected will go through a carefully graded course of study, including actual work in properly fitted laboratories, and that after this they will be brought into contact with the sick, and thus obtain practical experience of the duties and responsibilities of the practitioner of medicine before they offer their services as such to the public.

So much our physicians desire of every medical school, for the sake of the honor and dignity of the profession, and for the good of the public, and they desire especially that this school shall form an example to which they can point as showing how medical education should be conducted, and what should be required of the candidate for the degree of doctor of medicine.

The very general interest in the combined Hopkins trusts felt by physicians and scientific men not only of this country, but of the whole civilized world, is largely due to the belief that the relations which will here exist and be maintained between the University as a whole and its medical department, of which this Hospital is to be an important part, will be close and intimate, so that the true university spirit will pervade, stimulate and encourage the hospital work. In this country medical schools have either had no connection with universities properly so-called, or the connection has been slight and nominal, such as depends upon the formal conferring of medical degrees by the university. Here, however, through the influence of the biological department, there are secured common interests and mutual influence, and it is hoped, therefore, that the necessary details of technological instruction will be arranged in accordance with and subordinate to the broad principles of scientific culture upon which this University is organized.

It is because it is believed that this will be the case that there is a widespread hope and expectation that these combined institutions will endeaver to produce investigators as well as practitioners, to give to the world men who can not only sail by the old charts, but who can make new and better ones for the use of others. This can only be done where the professors and teachers are themselves seeking to increase knowledge, and doing this for the sake of the knowledge itself;—and hence it is supposed that from this Hospital will issue papers and reports giving accounts of advances in, and of new methods of acquiring knowledge, obtained in its wards and laboratories, and that thus all scientific men and all physicians shall share in the benefits of the work actually done within these walls. But, however interesting and valuable this work may be in itself,

it is of secondary importance to the future of science and medicine and to the world at large, in comparison with the production of trained investigators, full of enthusiasm, and imbued with the spirit of scientific research, who will spread the influence of such training far and wide. It is to young men thus fitted for the work that we look for the solution of some of the myriad problems which now confront the biologist and the physician.

Do I seem to ask too much? to be too sanguine as to what human thought, and study, and skill may accomplish? to forget that there is one event unto all; that the shadow of pain and death comes on the wise man as on the fool? I have two answers. As surely as our improved methods of prevention and treatment, based on the advances in knowledge of the last fifty years, have already extended the average duration of life in civilized countries nearly five years, have prolonged thousands of useful and productive lives, and have done away with the indescribable agonies of the pre-anæsthetic period, so surely we are on the verge of still greater advances, especially in the prevention of infectious and contagious disease, in the resources of surgery against deformities and morbid growths, and in the mitigation of suffering due to causes which cannot be wholly removed. But the second answer is more important, and it is this: It is our duty to try to increase and diffuse knowledge according to the means and opportunities which we have, and not to rest idle because we cannot certainly foresee that we shall reap where we have strewn. "It is not incumbent on thee to finish the work, but thou must not therefore depart from it," says the Talmud, and "Of him to whom much is given much shall be required," says the Scripture.

To you, the officers of this institution, and to you, men and women of Baltimore, there is now given the opportunity of giving powerful aid in this increase and diffusion of knowledge of the laws of human life, disease and death. Surely, those who are working in the wards and laboratories of the Hospital and University will do their best; surely, also, the citizens of this great city, of a great nation, which at no distant day will take the lead in scientific work, will encourage, sustain and sympathize with these workers. I would have this Hospital become famous, not for fame's sake, but because this will be evidence of the good work which has been done in it; but we must not be impatient. There are difficulties to be overcome, delays which must be submitted to. We cannot at once have the medical school which is essential to the plan which I have sketched; but there is plenty to do for the present, and I am certain that in time all these present obstacles to full development will be happily overcome.

Success in this, as in all other enterprises in this world, is to be obtained by unselfish work for the good of others, by wise counsel, by co-operation, and by persistent effort.

A hospital is a living organism, made up of many different parts having different functions, but all these must be in due proportion and relation to each other, and to the environment, to produce the desired general results. The stream of life which runs through it is incessantly changing; patients and nurses and doctors come and go; to-day it has to deal with the results of an epidemic, to-morrow with those of an explosion or fire; the reputation of its physicians or surgeons attracts those suffering from a particular form of disease, and as the one changes so do the others. Its work is never done; its equipment is never complete; it is always in

need of new means of diagnosis, of new instruments and medicines; it is to try all things and hold fast to that which is good.

"Et quoniam variant morbi, variabimus artes."

It has been said that "hospitals are in some sort the measure of the civilization of a people," but a hospital of this kind should be more than an index. It should be an active force in the community in which it is placed. When the mediæval priest established in each great city in France a Hôtel Dieu, a place for God's hospitality, it was in the interests of charity as he understood it, including both the helping of the sick poor and the affording to those who were neither sick nor poor an opportunity and a stimulus to help their fellow-men; and doubtless the cause of humanity and religion was advanced more by the effect on the givers than on the receivers. It is the old lesson so often expounded, apparently so simple and yet so hard to learn, that true happiness lies in helping others; that it is more blessed to give than to receive.

In some respects we to-day have a much wider outlook than the men of a thousand years ago. This Hospital is designed, as I have told you, to advance medical science as well as to give relief to the sick poor, but the fundamental motive is the same—to help others.

We have here the beginning of an institution which shall endure long after the speakers and the audience of to-day shall have finished their life-work and have passed away. Founded in the interest of suffering humanity, intimately connected with a great University, amply provided with what is at present known to be essential to its work, we have every reason to predict for it a long and prosperous career, with steadily progressing improvement in its organization and methods, and enlargement of its activity and influence.

Let us hope that before the last sands have run out from beneath the feet of the years of the nineteenth century it will have become a model of its kind, and that upon the centennial of its anniversary it will be a hospital which shall still compare favorably, not only in structure and arrangement, but also in results achieved, with any other institution of like character in existence.

STATISTICS OF CONSTRUCTION.

The following summary of materials employed and work done is taken from the report of the Superintendent of Construction, Mr. Lecke, for the year 1887, and will serve to give some idea of the magnitude of the work :—

Amount of excavation, 201,180 cubic yards. Amount of concrete foundations, 31,000 cubic feet. Amount of drain and terra-cotta pipe laid, 30,000 feet. Amount of concrete pavement laid, 107,272 square feet. Amount of granolithic pavement laid, 42,457 square feet. Asphalt floors laid, 19,443 square feet. Number of bricks used, 20,100,000. Cement used, 22,000 barrels. Lumber, 2,522,000 feet. Sash weights, 38 tons. Sash cord and chain, 32,763 feet—equal to six miles. Number of sash pulleys, 6000. Glass, 8200 lights. Nails, 1200 kegs. Iron, cast and wrought, 2557 tons. Copper, 30½ tons. Slate and metal roofing, 220,500 square feet. Length of pipe for hot water, steam, gas and water, from ¼ inch to 26 inches in diameter, 233,600 feet—equal to 44¼ miles. Tile arches and partitions 203,377 square feet. Railing, wrought iron, 2725 feet. Gas pipe railing, 1860 feet. Number of trees, shrubs and plants set out, 3067. Amount of top soil brought on the ground for gardens, etc., 9333 cart-loads.

THE HOSPITAL GROUNDS

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The grounds upon which the Hospital is built are located in East Baltimore, between Broadway and Wolfe Streets on the west and east, and between Monument and Jefferson Streets on the north and south; and include an area of about fourteen acres; measuring about 856 feet from east to west, and 708 feet from north to south. The streets which would have crossed this area have been permanently closed by Act of the Legislature of the State of Maryland.

The grounds are on the side of a hill, near its summit, sloping towards the southwest, the lowest point being at the southwest corner—87 feet 6½ inches above mean tide—and the highest at the northeast corner—115 feet 6 inches above mean tide. This hill is part of a ridge formed by the great fault, or line of displacement of the earth's crust, which runs along the Atlantic coast from below Savannah to the Hudson River, being a part of the original shore which has been several times sunk beneath the surface of the sea and again raised. While it was above the sea level, the clay of which it was formed was cut through by numerous streams; when it again sunk, the gullies thus formed were filled with sand and gravel.

At one time, while it was submerged, a thin layer of bog iron was formed. The result of this alternate rising and sinking, of the formation of gullies and hollows in the clay, and the filling these with deposits of different material, has been to make the ground an irregular series of alternate layers of sand and stiff clays, much folded and contorted; and, in some places, small underground

basins filled with sand and water have formed in the clay. Two springs, and several wet and marshy places, existed on the ground, being outlets of water which fell upon that portion of the hill above the lot, and which came to these wet points through underlying sand-layers and veins. From a series of trial-borings, it was found that these sand-veins lay so deep on the eastern part of the ground that it was impossible to reach them there and thus cut off the supply. Hence it was necessary to use a somewhat elaborate system of drainage for the whole grounds in order to insure the dryness so requisite for a healthful site, and to obtain firm foundations for the buildings. Upon the northeast corner of the lot was situated the building of the old Maryland Asylum for the Insane, with which was connected a series of drain pipes and privy wells, the location of most of which had long been forgotten, and which were only discovered in the process of draining the grounds. Upon the west part of the grounds were three old cemeteries, the principal one being almost on the site occupied by the Administration Building. These were excavated, and not only were the skeletons and remains removed, but also all the contaminated earth around and beneath them for a considerable distance. The system of drainage adopted is shown on Plate No. 2.

The nearest and most convenient point for discharging drainage into a public channel was the Harford Run, on Jefferson Street. By permission of the city authorities, a sixteen-inch tile pipe was laid from this point to the southwest corner of the Hospital lot, being a total distance of 1594 feet, with a fall of 53 feet. Subsequently, this was turned into the new Harford Run sewer at Eden Street. Where this drain crossed streets, iron pipe was used. At the southwest corner of the grounds, being at their lowest point, this sixteen-

inch main drain enters a large silt trap, a horizontal section of which has the shape of a quarter of a circle. The bottom of this silt trap is at the level of 75 feet 9 inches above mean tide, and the sixteen-inch pipe above referred to enters it 3 feet 9 inches above this level. To this silt trap is brought a large part of the drainage of the Hospital grounds; it being distinctly understood that it has no connection in any way with sewerage, but is exclusively devoted to the removal of surface water, subsoil drainage, and of the discharges of water from the roofs. The location and direction of the drains connected with this silt trap are shown on the plan.

One of the springs above referred to was situated near the southeast corner of the lot, just north of the laundry; the swamp referred to was located on the site of the male pay ward, between that and the administration building. Another spring was situated near the northeast corner of the kitchen building. In order to avoid the expense of digging a trench about 850 feet long and 12 feet deep to drain this spring, it was determined to make use of a system of perpendicular drainage for this portion of the lot. Two wells of five feet diameter, indicated on the plans as drainage wells, between the amphitheatre and the kitchen, were sunk to water, where a bed of coarse gravel was struck at a depth of 77 feet. Into these wells the water from the spring, and some other small veins of water opened in excavating, were turned, and the result has been satisfactory.

This system of soil drainage has continued to give excellent results, and has not only insured suitable dryness of the Hospital grounds, but also of the cellars on the opposite side of Broadway below the Hospital. The main drains connected with the silt trap, as shown on the plan, one on the south and the other on the west

side of the lot, are each ten inches in diameter at their point of discharge. By the side of each main drain pipe lies a four-inch tile drain for the removal of local moisture. These two large drains receive the discharge from four longitudinal pipe drains crossing the lot from east to west, into which tile pipe drains arranged as laterals open in the usual way, and also the tile drains laid around the foundations of each building. The total amount of tile drains laid is between five and six miles.

The slope of the lot required a very considerable amount of grading in order to make it suitable for the plans of building adopted, the soil being removed from the north and east to form the terraces on the south and west. Not a single foot of the surface of the lot is now at its original level.

The air in this soil contains a high proportion of carbonic acid gas, three analyses made by Dr. Abbott of the air taken at a depth of five feet beneath the surface showing an average of 120 parts per 10,000, and this fact has to be constantly borne in mind in determining the amount of carbonic acid gas due to exhalation from the lungs and skins of inmates in the wards. In the course of digging the well situated south of the Nurses' Home, it happened several times that carbonic acid gas accumulated in the excavation to such an extent that the workmen could not remain in it until the gas had been removed by mechanical means.

GENERAL ARRANGEMENT OF BUILDINGS ON THE GROUNDS

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The arrangement of the buildings upon the grounds is shown in the block plan, Plate 2. The main front of the Hospital, and the principal entrance, is on Broadway, facing to the west, and having an excellent view of the city across the valley of Jones's Falls. The buildings upon this main front, and especially the administration building, with the two pay wards, may be said to embody the architectural features of the Hospital, all the other buildings having comparatively plain exteriors. The general effect of the main, or west, front is shown in Plate 1.

The buildings having special relations to the educational features of the institution—namely, the Amphitheatre, Dispensary, and Pathological Laboratory—are located on the northeast, in proximity to grounds owned by the Johns Hopkins University on the northeast corner of Monument and Wolfe Streets, upon which grounds the buildings of the Medical Department of the University are to be erected. The block plan shows the Hospital buildings thus far erected. In addition to these, the original complete plan provides for a row of five wards on the south side, opposite to, and corresponding with the octagon, three common, and isolating wards now constructed on the north, thus partially enclosing the large central lawn or garden, which, as before stated, is an essential feature of the plan. The original plan also provides for the erection of a large greenhouse on the south front, midway between the laundry and the nurses' home. The open space on the east, front-

ing on Wolfe Street, is reserved for tents, or temporary wooden buildings, in case of the outbreak of an epidemic. It should be remembered that the buildings intended for administrative purposes are of a size suited to the original complete plan, and will be ample when all the wards are erected.

All the buildings except the gate lodge, the pathological laboratory, the laundry, and the stable, are connected by a covered corridor, as shown in the block plan. The floor of this corridor is at the uniform level of 114 feet above mean tide, being the level of the main floors of the administration and apothecaries' building, the kitchen, nurses' home, and bath house. The top of this corridor is nearly flat, forming an open terrace walk at the uniform level of 124 feet above mean tide, being the level of the ward floors. This arrangement permits a perfectly free circulation of air between and around the buildings above the level of the ward floors, and secures the best influence of the prevailing southerly winds. As will be seen in the description of the ward buildings, it is not possible to pass to or from the octagon or either of the common wards without going into the free external air, so that there can be no communication between the air of different wards. Beneath the corridor is a passage-way containing the pipes for heating, lighting, water supply, sewage, etc., which is called the pipe tunnel, although it is above the level of the ground for more than half its height, and is, therefore, a half basement passage, rather than a tunnel. It will be described more in detail in connection with the system of heating and ventilation. An interior view of the west corridor is given in Plate 4, and a corresponding view of the pipe tunnel in Plate 6.

GENERAL CONSTRUCTION OF BUILDINGS

GENERAL CONSTRUCTION OF BUILDINGS.

The buildings are constructed of brick, with trimmings of Cheat River stone and of moulded terra-cotta. The Cheat River stone is a very fine-grained, compact sandstone of a bluish-gray color, which harmonizes excellently with the red brick. It is obtained from West Virginia, and is one of the most durable of our building stones, especially when laid on its natural bed, *i. e.*, in the same relative position which it had in the quarry—and care has been taken that it should always be so laid in these structures. The buildings on the main, or west, front are constructed of the best quality of pressed brick; the other buildings of what is known in this vicinity as sand brick, being intermediate in quality between pressed brick and the ordinary hard brick of commerce. The foundations of the principal buildings consist of a solid concrete base; for the other buildings they are broad flags of Port Deposit granite. All foundation and interior walls are of hard brick, laid in Cumberland cement below the ground level, at which point they are covered by a layer of heavy slate. Lines of drain tile are laid around the foundations, and for all the buildings having cellars or half basements, the outer surface of the walls beneath the ground is sheathed with overlapping slates. Above the horizontal layers of slate at grade, the walls are hollow, with a two-inch air space nine inches from the inner surface. This air space is closed in for two or three courses of brick at the top.

All pitched roofs are covered with carefully selected Peach Bottom slate laid on English asphalt felt, and secured with copper

nails. The comparatively flat portions of the roofs of the pay wards are covered with copper, which is also used for all gutters, flashings and down spouts on the administration building, the nurses' home, kitchen, apothecaries' building, and all the ward buildings. The floors of the principal buildings, and of the corridor, are formed of moulded hollow blocks of hydraulic lime of Teil laid between iron beams of suitable size, and covered with wood, concrete or asphalt. Such floors are fire-proof, and are much lighter than those constructed with solid brick arches. The floors of the basements are of artificial stone laid in large blocks, and underneath all heat coils is placed a heavy coat of asphalt to prevent the passage of ground air up through the coil.

The floors of the pipe tunnel and of the kitchen are of concrete. The floor of the corridor and of the bath house is what is known as granolithic, being composed of cement and ground granite, laid in blocks of suitable size, and forming a very hard, smooth and durable covering which is easily cleaned. The floors of bath rooms, water closets and lavatories are of asphalt. The floors of the main kitchen and of all tea kitchens are of concrete. The floors of all wards and rooms for the sick are of edge grain Georgia pine $1\frac{1}{8}$ inches thick, which was soaked in water for six months and then preserved dry for several years before it was dressed for use, in order to secure the removal of all soluble matters and thorough seasoning.

All walls are plastered in three coats, and, for the most part, finished with a hard trowelled sand finish, preparatory to being painted in oil. All walls were allowed to stand for at least two seasons before being plastered, in order to permit of thorough settling and to minimize the risk of cracking of the plastering as

much as possible. The walls being hollow, the plastering is laid directly on the inner surface of the brick. In the pathological laboratory, the bath house, and the female pay ward, a finish composed of finely-ground soapstone with plaster of Paris was used with very satisfactory results. It is more elastic and less brittle than the ordinary hard finish, and therefore less liable to crack, becomes sufficiently hard after about a year's exposure to permit of cleansing by rubbing with soap and water, and has an agreeable French gray color. In all rooms in which wooden beams were used for the ceilings, including the wards, wire netting was used in the ceiling in place of wooden lath, in order to prevent cracking of the plastering, and to secure a fairly fire-proof construction. The stairways in the wards are of iron, with a layer of asphalt in the treads. In all wards and rooms occupied by the sick, woodwork is very sparingly used. Window sills are of slate. The woodwork is of ash, and is free from quirks, grooves and broken surfaces, having plain bevelled or rounded mouldings, which do not afford catch-places for dust, and are easily cleaned by rubbing with a damp cloth. The windows are finished with plain half-round heads and mouldings. The doors of the wards are self-closing by means of double-acting springs sunk in the threshold, being the Archibald Smith & Stevens patent.

The wards are supplied with outside shutters, so constructed that they can be opened above and below in the ordinary manner, or the lower half of the shutters can be tilted outwards to form a sort of awning, permitting free admission of air, while largely excluding light. The roofs are high-pitched, giving an ample space above the ceilings, which space is ventilated, and thus the heat of the sun upon the slate roofs during the hot summer months does not affect the wards.

The walls of the wards are painted in oil, of a French gray color, somewhat darker below for a height of six feet. All hard wood is finished in hard oil. In the upper stories of the administration building and nurses' home the woodwork is painted white. In the kitchen and the upper stories of the apothecaries' building the woodwork is painted light gray.

The glass in the windows of the administration building and the pay wards is French plate—in all other buildings it is first quality French double-thick.

Heating and Ventilation.

All the wards, the administration building, the nurses' home, the apothecaries' building, and the kitchen, are heated mainly by a system of circulation, through iron pipes, of hot water of comparatively low temperature and pressure, the heat being furnished by boilers at the kitchen and nurses' home. In many of the rooms in these buildings, including all the private, or isolating, rooms for patients, and all living rooms in the administration building, open fire-places are also provided, but these will probably be rarely used. The amphitheatre, dispensary, and bath house are heated by steam furnished from boilers at the kitchen building. The pathological laboratory and the laundry are heated by steam, each having its own boiler. The general distribution of the hot water and steam systems is shown in Plate 4.

The hot water boilers for heating are six in number, four being in the vaults at the kitchen building and two in the cellar of the nurses' home, all being on precisely the same level—viz.: 85 feet above mean tide. Each of these boilers is five feet in diameter and sixteen feet long, and contains 106 three-and-a-half-inch tubes or

flues. From the boilers the heated water passes into the great outflow main, which is a cast-iron pipe 26 inches in inside diameter, hung on rollers from the ceiling of the pipe tunnel, as shown in Plate 6, and provided with expansion joints just outside the kitchen building. A view of one of these expansion joints is given in Plate 7, and the plans are shown in Figs. 2 and 3, Plate 31. From this main flow pipe, pipes are given off at each building, and from these smaller mains the pipes in the heating coils are supplied. From these heating coils the cooled water returns by a similar system of pipes and mains to the boilers. This circuit is practically a closed one; none of the water being drawn off, or used, at any point, so that there is very little loss. The force which produces this circulation is a small one, being the difference in weight of a column of heated water from that of a similar column of water of from 8 to 15 degrees F. lower temperature, each column being about 29 feet high, which is the difference between the level of the water in the boilers and that of the top of the heating coils. By means of valves on all the mains, and on the supply and the discharge pipe to each coil, the rapidity of the circulation can be controlled for each building and for each coil, thus giving a corresponding control over the temperature of the coils themselves, since this is dependent on the amount of water of a given temperature which passes through the coil in a given time. The entire system of hot-water-heating contains about 175,000 gallons of water, and practical trial has shown that it produces an equable, agreeable temperature in all the buildings to which it is applied, in all conditions of cold weather, and with the fullest ventilation desired. To prevent loss and waste of heat from the mains in the pipe tunnel, and in the basements of the several buildings, these pipes are covered with

felt, enveloped in asbestos paper, and the whole is enclosed with stout canvas thoroughly painted. The effect of this protection is marked and satisfactory—very little heat is lost, as is shown by the temperatures in the pipe tunnel, and a great saving of fuel is thus effected. The heating coil most distant from the kitchen boilers is that in the southeast end of the isolating ward, being 763 feet away, as measured along the tunnel and basement of the ward.

The great advantages of this system of heating for rooms constantly occupied by the sick, in the climate of Baltimore, are its uniformity of action, the comparatively low temperature of the heating surfaces over which the air is passed, the ease with which different temperatures may be secured in different rooms, or even for different beds in the same room, and, above all, that it ensures the delivery of a large supply of air heated to the temperature required for comfort without the risk of overheating or of sudden changes.

This will appear more fully when we come to speak of the ventilation, and especially of the ventilation in the sick wards.

The heating of the amphitheatre and dispensary is effected by low-pressure steam furnished by boilers at the kitchen building and conveyed through pipes carried direct from the boiler vaults to the amphitheatre, through an underground tunnel eight feet high specially constructed for that purpose. Steam-heating was selected for these buildings, partly because they are not constantly occupied, and it is desirable to have the means of raising the temperature in them more rapidly than can be done by the circulation of hot water, and partly because it was desired to have the means of careful comparison of the two systems of heating for experi-

mental and teaching purposes. For purposes of experiment and observation, thermometers are fixed at various points in the flow and return pipes of the hot-water-system in order to determine the temperature of the water at various distances from the source of heat, and before and after it has passed through the heating coils and given off some of its caloric to the air passing up between the heating surfaces.

Two pieces of apparatus have been inserted for the purpose of determining the velocity of the current of hot water in the pipes under various circumstances of external temperature, and thus obtaining data as to the amount of water producing a given heating effect in a given time. One of these is placed in the basement of the octagon ward, the other near the point most distant from the boiler in the isolating ward. The plan of this apparatus is shown in Fig. 5, Plate 5.

It consists essentially of a by-pass connected with one of the smaller supply pipes in such a way that all the water coming through this pipe can be sent through a glass tube having the same diameter as the pipe, in which glass tube the velocity of the stream can be measured by injecting a small quantity of colored fluid, such as a solution of carmine, and noting the time required for it to pass a measured distance in the glass tube.

With a temperature of 92.6° F. in the flow pipe and 85.4° F. in the return, the rate of flow as determined by this apparatus is 13.5 feet per minute. With a temperature of 134.8° F. in the flow pipe and 129.7° F. in the return, the velocity was found to be 16 feet per minute. The following tables indicate the radiating surface for the different buildings and for some of the more important rooms:

Table Showing the Radiating Surface in the Steam Coils for Buildings and Rooms Heated by this System.

Building or Room.	Cubic Feet of Space Heated.	Square Feet of Radiating Surface.
Amphitheatre—Main Room	55,614	1,216
Dispensary—Main Room	56,911	4,824
Pathological Building—Amphitheatre	26,019	492
Laundry Building—Total	59,544	1,071
Ironing Room	15,194	160
Drying Room for Patients' Clothing	1,664	340

Table Showing the Number of Square Feet of Radiating Surface in the Hot Water Coils for the more Important Buildings and Rooms Supplied by this System.

Building or Room.	Cubic Feet of Space Heated.	Square Feet of Radiating Surface.
Administration Building—Total	429,441	17,881
Superintendent's Office	14,973	630
Pay Ward—Total	147,554	7,947
Single Room for Patients	2,606	162
Nurses' Home—Total	229,104	9,394½
Each Room	1,760	85
Octagon Ward—Ward	44,192	2,400
Bay Window in Ward	2,400	60
Nurses' Closet and Bath Room	3,184	150
Dining Room	4,323	200
Common Ward—Total	78,880	5,307
Main Ward	39,766	3,150
Private Ward	3,570	262½
Dining Room	3,570	262½
Water Closet and Lavatory	2,924	162
Foot-plate in Sun Room	1,886	131
Isolating Ward—Total	59,295	4,645½
Single Room	2,145	162
Apothecaries' Building—Total	79,463	3,410

The following table gives the dimensions and capacity of the hot water boilers in the different buildings. The water in these boilers is heated by steam.

Table Showing Dimensions of Bath or Hot Water Boilers—Wrought Iron.

BUILDING.	NUMBER.	DIMENSIONS.	CAPACITY.
Isolating Ward	1	2′6″ diam. × 5′6″ long.	200 Gallons.
Common "	1	2′6″ " × 6′0″ "	220 "
Octagon "	1	3′0″ " × 7′0″ "	370 "
Amphitheatre Building	1	2′6″ " × 5′0″ "	183 "
Dispensary "	1	2′0″ " × 7′0″ "	165 "
Kitchen "	1	3′0″ " × 8′0″ "	423 "
Male Pay Ward	1	3′0″ " × 7′0″ "	370 "
Administration Building	1	3′0″ " × 7′0″ "	370 "
Apothecaries' "	1	3′0″ " × 7′0″ "	370 "
Nurses' Home "	1	3′0″ " × 7′0″ "	370 "
Bath House "	2	2′6″ " × 6′0″ "	440 "
Laundry "	1	2′6″ " × 13′0″ "	477 "

The following gives the dimensions of the steam boilers:

Steam Boilers—Horizontal Tubular.

Kitchen Building,	3	60″×16′ 0″	Boilers with	58	3½″	tubes each.	
Laundry "	2	42″×11′ 0″	" "	38	3″	"	"
Pathological "	1	36″× 9′ 0″	" "	28	3″	"	"

Accelerating coils of one-inch pipe, heated from the high-pressure steam boiler at the kitchen building, are placed in all the principal aspirating shafts, as indicated in the description of the several buildings. The following table shows the number of square feet of radiating surface of steam pipe in each accelerating coil, the area of the shaft in which it is placed, and the height of the shaft above the coil:

Coils in Aspirating Shafts.

	SQUARE FEET OF RADIATING SURFACE.	AREA OF SHAFT.	HEIGHT OF SHAFT ABOVE COIL.
Administration Building, W. C. Shaft	50	28″× 36″	15 feet.
" " Bath Room Shaft	40	24″× 30″	15 "
Apothecary " W. C. Shaft	30	3′5″× 14″	12 "
" " Vent, 2 cylinders 36″ inside	25		Coil in S. E. only 20 feet.
Nurses' Home " W. C. Shaft	30	24″× 32″	25 feet.
" " " " "	30	24″× 32″	25 "
" " " Vent "	150	6′× 3″×6′3″	25 "
Male Pay Ward " " "	72	2′ × 2′6″	20 "
" " " W. C. "	40	30″× 24″	20 "
" " " Slop Sink Shaft	30	30″× 24″	20 "
Female " " Vent "	72	2′ × 2′6″	20 "
" " " W. C. "	40	30″× 24″	20 "
" " " Slop Sink "	30	30″× 24″	20 "
Bath House " W. C. and Vent Shaft	50	30″× 18″	12 "
Kitchen " W. C. Shaft	60	36″× 24″	12 "
Common Wards, each Ward "	70	5′2″× 5′2″	30 "
" " Service "	56	4′ × 4′	12 "
" " W. C. "	60	24″× 36″	30 "
Octagon Ward, Ward "	130	8′ × 8′	30 "
" " Service "	64	4′ × 4′	12 "
" " W. C. "	50	3′ × 3′	30 "
Isolating " Commode Closets, each Shaft	40	2′6″× 18″	40 "
" " W. C. Shaft	40	36″× 2′	10 "
Amphitheatre Building, Vent Shaft	160	6′ × 6′	25 "
" " W. C. " West	20	1′ × 4″	2 "
" " " " East	20	1′ × 2″	2 "
Dispensary " Vent "	160	6′ × 6′	25 "
" " W. C "	20	8″× 12″	2 "
" " " "	20	8″× 12″	2 "
Autopsy " North Vent Shaft	54	3′ × 3′6″	30 "
" " South " "	54	6′ × 6′	30 "

Laundry	"	Main " "	5′0″×5′0″	Boiler Smoke, 24″ diam.
"	"	Drying Room "	5′0″×5′0″	Ironing Stove, 12″ "
"	"	W. C. "	14″×13″	Steam Pipe, 4″ 7 sq. ft. rad. sur.

Closely connected with the heating apparatus are many of the arrangements for ventilation. The external temperatures at the Hospital have a range of from 102° F. in summer, to six degrees below zero F. in winter, these extremes occurring about once in ten years. To provide for these requires buildings and apparatus which would be satisfactory in either Calcutta or St. Petersburg. Let us first consider the arrangements for ventilation in cold weather. In the wards, and rooms occupied by the sick, the sizes of flues and registers, and the amount of heating surface, have been arranged for a supply of one cubic foot of fresh air per second for each person in the ward, with the possibility of doubling this supply for a short time in flushing out the ward, as will be presently explained. In the pay wards, where each patient has a separate room, making it more difficult to secure thorough distribution, the supply of air is to be one and a half cubic feet per second per head. In the isolating ward, designed for cases giving rise to offensive odors or in which a large amount of organic matter is thrown off, or in which, for other reasons, a large amount of air is desirable, the air supply is fixed at two cubic feet per second per head. Finally, three rooms in the isolating ward are arranged with perforated floors (see Figs. 1 and 2, Plate 26) for an air supply of four cubic feet per second per head, with capacity for doubling this if desired. For all the wards the air is warmed in cold weather before it is admitted to the room, forming the so-called method of heating by indirect radiation or by air convection. All registers and flues for fresh air are of such sizes as to permit the passage of the requisite amount of air with a velocity not exceeding one and a half feet per second under ordinary circumstances. Air currents of this velocity having a temperature of from 70° to 75° F. are

barely perceptible by the hand, and create little or no discomfort. The fresh air registers are as a rule placed in the piers in the outer walls, at a height of nine inches from the floor, one register being allowed to each pair of beds. Besides these there are registers beneath the windows in the wards, which are only used in very cold weather, to check the down draughts produced by the chilling of the air through the glass of the window. The chief register, being that in the pier between each pair of beds, is so arranged that the nurse, by turning an iron arm upon its face, can reduce the temperature of the incoming air nearly to that of the external air, or can increase it to the maximum which the heating coil affords, but without changing the quantity of the air admitted. Ordinarily, as is well known, when a room heated by indirect radiation becomes too warm, the only way to shut off the heat supply is to close the register and thus shut off the air supply also, but in these wards the temperature can be regulated at the different registers, in different parts of the room, to suit the needs of different patients, without interfering with the air supply.

The mechanism by which this is effected is shown in Fig. 2, Plate 22.

The following memoranda are furnished by Dr. A. C. Abbott as the results of observations made of the workings of this apparatus in one of the common wards during the month of December, 1889, the average number of patients in the ward being twenty-four.

In the main ventilating shaft of the ward, the accelerating coil being heated, the velocity of the ascending current was 3.8 feet per second, giving a total flow of 95 cubic feet of air per second, being nearly 4 cubic feet per second per head. When the accelerating coil was not heated, the velocity was 2.8 feet per second. In the

water closet shaft of the common ward, measuring 24 × 36 inches, the velocity of the ascending current was 188 feet per minute. The velocity of the air currents entering through the registers varied from 1.6 to 3.3 per second, depending upon the adjustment of the valve for admitting the outer air freely to the coils.

The following table shows the average temperatures, the mean relative humidity, and the mean dew point of the outside air as compared with the corresponding figures for the air in the wards:

Month.	Temperature of outside air.			Temperature of air in ward.			Mean rel. humidity.		Mean dew point.		Mean temp. in coils.		Velocity of incoming air.
	Max.	Min.	Mean.	Max.	Min.	Mean.	Outs'e.	Inside.	Outs'e.	Inside.	Flow.	Ret'rn.	Average.
November .	67°	27°	44.2°	75.5°	62.4°	70.4°	70.7%	33.2%	34.7°	38.5°	119.7°	110°	3 feet.
December .	50.1°	33.3	43.6°	74.5°	67.3°	70.5°	73%	34.2%	34.8°	39.8°	134.8°	129.7°	3.3 feet.*

* *i. e.* 1.6 feet per bed per second.

The carbonic acid determinations made by Dr. Abbott to determine the distribution of the fresh air within the ward are not yet sufficient in number to give positive results, chiefly owing to the fact that very great variations are found in the proportion of the carbonic acid in the external air due to the direction of the wind and to other circumstances. In general, however, it may be said that the proportion of carbonic impurity due to the respiration of patients in the ward is about 2 parts in 10,000, and the above table, showing the comparison of dew points and relative humidity of the outer air and the air in the ward, indicates that the vapor and other impurities added to the air by the respiration of the patients in the ward is removed almost as rapidly as it is formed. As regards temperature, it is certain that the wards can be kept at

a temperature of 70° F. in the coldest weather, while at the same time such ventilation is being secured in the ward that a person with a normal sense of smell coming from the fresh external air shall at no time perceive any trace of musty or animal odor. A systematic series of observations of temperature, dew point and relative humidity of the external air in the central garden and in the wards are now being carried on, the observations being made at 8 A. M. and 8 P. M., and from these, taken in connection with the corresponding series of carbonic acid determinations in the wards and in the external air to be made by Dr. Abbott throughout the coming year, all of which will be duly published, the operation of the heating and ventilation apparatus can be determined with scientific precision. At present it is sufficient to say that it amply fulfils the purposes for which it is designed, and furnishes and properly distributes within the wards an amount of fresh air heated to an agreeable temperature, which is, if anything, in excess of the requirements laid down by the best authorities on hygiene.

Water Supply.

The water supply of the hospital is taken from the general supply of the city of Baltimore, mainly through a 6-inch pipe which enters the centre of the street front of the boiler vaults at the kitchen building. In these vaults it passes through two large filters of the Loomis patent. These are iron cylinders six feet high and two feet in diameter, nearly filled with clean sand. At intervals of about twenty-four hours the direction of the current through these filters is reversed, and the accumulated impurities are washed out into the street. The straining effect of these filters is shown by the bacteriological examinations of the water which have been

made in the hospital. Before filtration the water contains an average of 39 micro-organisms per cubic centimeter; after filtration the average number found is 6 per cubic centimeter. The arrangement of these filters is shown in Fig. 4, Plate 32.

As these filters greatly obstruct the free supply of water which would be requisite in case of a fire, although they permit the passage of an ample supply for ordinary use, a by-pass around them is arranged so that in case of necessity the steam pump can draw directly from the street main. This steam pump is connected to force water into large tanks placed in the attic of the annex to the administration building. These tanks or reservoirs have a capacity of 31,843 gallons, and are intended both to contain a reserve supply for use in case of temporary interruption of the supply from the street main owing to breakage, etc., and to give additional head or force when the pressure in the street mains is too small to produce the desired effect.

Sewage Disposal and House Drainage.

Baltimore has no system of sewerage. From the majority of the houses the soiled water from kitchen sinks, laundries, baths, etc., is allowed to run into the open gutters, while excreta are discharged into privy pits, wells, cesspools or boxes. Some of these are comparatively water-tight, and are cleaned out at stated intervals or when they become full and offensive; many of them allow of more or less leakage of their contents into the surrounding soil, while some are in the form of deep wells extending to the underlying gravel, and are seldom or never cleaned out. This last was the arrangement for the old Maryland Asylum for the Insane when it was upon the hospital grounds, and several such wells

were found in the process of grading and laying soil drains. In arranging for the disposal of the fouled water from the various buildings, the water closet and ward sink sewerage was kept distinct from that coming from the kitchen sinks, wash basins, etc. The discharges from ward water closets and sinks, and from all water closets and housemaid's sinks in the administration building, the apothecaries' building, the kitchen, and the nurses' home, are conveyed by a separate system of iron pipes from each building to an iron pipe which runs in the pipe tunnel from the isolating ward on the east to the point where the corridor to the female pay ward is given off. Here this pipe leaves the tunnel, enters the ground, and passes to a well west of the nurses' home. (See Block Plan, Plate 2.) This well is seven feet in diameter and seventy-one feet deep. At the bottom it enters a stratum of coarse gravel and pebbles through which water is constantly, though slowly, flowing towards the southwest. At right angles to the direction of this subterranean stream, drifts or tunnels were excavated, running fifteen feet on each side of the well, and being two feet wide and five feet high. The bottom of this tunnel was formed by the water bearing stratum of gravel above described; its sides and crown were lined with brick laid without mortar or cement. This well is ventilated by a pipe which is carried in the ventilating shaft of the nurses' home to the top of the building. The well for the pathological building is five feet in diameter and eighty-one feet deep. That for the laundry is six feet in diameter and seventy-five feet deep. That for the amphitheatre and dispensary is six feet in diameter and seventy-seven feet deep.

While this is by no means an ideal method of sewage disposal, it was adopted as a temporary measure until the city shall be

provided with a proper system of sewers, which it is believed cannot be long delayed, and there is no reason to doubt that, so far as the hospital itself is concerned, it will dispose of its sewage for many years without danger to the health of its inmates or the production of nuisance. All pipe lines are laid with reference to connections with the city sewers when they are built.

The sewage from the pathological building, from the amphitheatre and dispensary, and from the laundry, is discharged into similar wells, the location of which is shown on the block plan. The water from wash basins, kitchen sinks, etc., is conveyed by a separate system of pipes to the street gutters or to the sixteen-inch pipe drain about ten feet beyond the silt trap in the southwest corner of the grounds. All soil pipe was delivered on the grounds as it came from the foundry, without being tarred or painted. It was then tested by passing through each length or section a swab dipped in a mixture of linseed oil and red lead. The slightest defect in the casting was indicated by the appearance of an oily stain on the external surface of the pipe. After passing this test the pipes were painted with red lead. All pipes are so placed as to be readily accessible and freely exposed to view.

The arrangement of soil pipes and plumbing within the building is in accordance with the plumbing regulations of the city of Baltimore, being the same, substantially, as that prescribed in New York and Washington. All fixtures have separate traps placed as close to the fixture as possible; all traps have back ventilation, and all perpendicular soil pipes extend upwards through the roof, full size, and open freely to the outer air. The soil pipes from the laundry, the pathological building, the amphitheatre, and the dispensary, are each trapped near the wells into which they empty, and have a fresh-air inlet inside the trap.

The water closets are washout closets, being what is known as the Brighton closet.

The bath tubs are of iron, are not enclosed with woodwork, stand upon iron legs clear of the floor, and are movable from place to place, being unconnected with the plumbing. The sinks are of porcelain; those for the use of the ward nurses and housemaids having an all-round flushing rim, as well as a central flush by means of a large draw cock. All the pipes and traps are either fully exposed to view or are readily accessible by opening a door. For all the wards the perpendicular soil and trap-vent pipes are placed in a sort of small closet or large ventilating shaft which extends above the roof and has in it an accelerating steam coil to secure a constant upward current. Into this shaft pass ventilating tubes from the water closets and urinals. The working of this system has proved in practical use to be very satisfactory.

Lighting.

All the buildings are at present lighted with gas, but all the wards and the administration building have been wired for lighting with incandescent electric lamps, whenever it shall be deemed best to adopt this mode of lighting. The gas fixtures are of special designs, and in all rooms occupied by the sick these designs are in simple rounded forms, so as to be easily cleaned and to retain as little dust as possible. (See interior views of octagon and of common wards, Plates 19 and 24.) These ward fixtures carry arrangements for incandescent lamps as well as for the ordinary gas burners. The number of burners in each building is as follows: administration, 466; apothecaries', 116; kitchen, 181; pay wards, 184 each; nurses' home, 349; common wards, 79 each; octagon

ward, 127; isolating ward, 90; amphitheatre, 70; dispensary, 96; bath house, 28; pathological building, 56; laundry, 50; corridor and tunnel, 40; gateway and gate house, 11;—total, 2285.

Clocks.

Pneumatic clocks are placed in all the wards, in the corridors, kitchen, administration building, and nurses' home. These clocks are all driven by pulses or puffs of air sent through small iron pipes from the central apparatus in the administration building, thus ensuring uniform timekeeping throughout the buildings.

Telephones.

All the buildings are connected by telephone with the clerk's office in the administration building, which also communicates with the general telephone service of the city. By means of a switchboard in the clerk's office any building of the hospital can be put in direct telephonic communication with any other building of the institution.

Provision has been made for a system of registration by electrical dials, or the so-called telemeter system, of the amount of air passing out of a common ward, and of temperatures at one or two points in the ward.

The Administration Building.

This building, the largest and, from the architectural point of view, the most important building of the hospital, is on the centre of the main front, and its external appearance as seen from Broadway is shown in Plate 1. It contains three floors besides a cellar and a finished attic story, is crowned with a dome and a spire in

the centre, and has an annex in the rear containing water closets and bath rooms. The height to the top of the dome is 150 feet, to the top of the spire 185 feet, to the top of the vane about 200 feet. The height from the main floor to the top of the inner dome is 79′ 9″. The brickwork rests on a battering base of four courses of rubbed Cheat River stone, rising to a height of 108 feet above mean tide. The cellar or half-basement is 14 feet high in the clear, is floored with concrete, and contains the hot-water coils for heating the building. The main or first floor contains the offices, library, reception, examination, and board rooms; the second floor is devoted to the living rooms of the Superintendent and resident physicians; and the third floor is intended for bed rooms for the resident students. The arrangement of rooms is shown in the plans of the first and second floors (Plates 8 and 9), and transverse sections of the building through the centre from north to south and east and west are shown in Plates 10 and 11. Entering the building by the porch on the west front, and passing through the vestibule, the visitor comes into the large central octagonal hall beneath the dome, which central hall has a large double staircase on the east, and opens into the main hall running north and south. At each end of this main hall is a vestibule entrance. The total length of the building, excluding the vestibules at the ends, is 184 feet; the length of the main hall from one inner vestibule door to the other is 170 feet 10 inches; the diameter of the central octagon beneath the dome from one pier to its opposite is 34 feet. This central hall is lighted through a central inner dome of ribbed glass, as shown in the section Plate 10. The floor of this hall is of marble tiles. The rooms on this floor, as well as the halls, are wainscoted and finished throughout in quartered oak. The staircase is also of oak. The plan of the rooms is shown in Plate 8.

The office on the right of the main entrance is devoted to the general records and business of the hospital, and contains a large fire-proof safe or vault, extending from floor to ceiling and divided into two stories. This office also contains the central telephone switch, by means of which communication can be had between any two buildings of the hospital; and the annunciator for the electric bells of the rooms in the upper stories of this building. The room marked Officer of the Day is for the use of the physician on duty. The room marked Board Room is for the use of the Board of Trustees, and contains the private library of Johns Hopkins, consisting of non-professional books. An interior view of this room is given in Plate 13. The library contains the medical library of the hospital, with the exception of the current periodicals, which are placed in the reading room. This main floor is on the level of the corridor floor in the rear—*i. e.*, 114 feet above mean tide. The height of the rooms in the main building and annex is as follows:

Main Administration.	Annex.
1st story, 17′ 4″ clear,	9′ 0″ clear.
2d " 13′ "	14′ 10″ "
3d " 12′ 9″ "	13′ 0″ "
4th " 12′ 6″ "	9′ 6″ "

The arrangement of the rooms on the second floor is shown in Plate 9; the third floor is substantially the same. This building is heated throughout by the hot-water system, mainly by indirect coils in the cellar, each room having a separate flue for fresh warm air supply. The ventilation is effected by this fresh-air flue in connection with the open fireplace and chimney flue connected with each living room. No water pipes are brought into the main

building except in the superintendent's rooms in the southeast corner of the second floor, and there are no fixed washstands. With the exception above noted, all water and soil pipes are confined to the rear annex building. On the upper floor of the annex are three boiler-iron water tanks capable of holding 31,843 gallons of water. (See Plate 11.) These tanks are filled by a steam pump in the kitchen boiler vaults, and are intended to secure a reserve supply of water at a higher pressure than that afforded by the city mains. The large vane on the top of the spire is arranged for electrical connections which, when made, will indicate the direction of the wind on a dial placed in the main central hall.

The Pay Wards.

The two buildings which are especially intended for the reception of private, or pay, patients, are situated on the west or Broadway front of the grounds, on either side and in front of the administration building, as shown on the Block Plan, Plate 2. Pay patients are also placed in the rooms connected with the common and octagon wards, and in the isolating ward, as circumstances may require, but these two buildings, being devoted exclusively to such patients, are known as the pay wards. Each of them is one hundred and thirty feet long, forty-nine and a half feet wide, and two stories high, with a cellar, and a rear projection in the centre containing the bath rooms, water closets, stairs, etc. The general arrangement of each floor is shown in Fig. 1, Plate 14. It will be seen that it contains a series of rooms opening from each side of a central corridor which runs north and south, and which opens at either end upon a veranda which has a roof, but is open at the sides and ends. At the point of junction of this corridor

with the east and west corridor of the rear, or administrative portion, is an octagonal hall, lighted from above.

The rooms for patients are each 15′ 5″ long, and vary in width from 12′ to 13′. Each of them has an open fireplace in the corner next the corridor. The fresh air is brought in through a register near the floor in the external wall, as shown in the plan; the arrangements for heating this air, and for regulating its temperature, being substantially the same as those for the common wards described hereafter, except that the air is taken from the interior, as shown in Fig. 3, Plate 15. Besides the open fireplace and chimney flue, each room has an exit flue, 9″×16″, in the inner or corridor wall next the fireplace, as indicated by the exit arrows in the plan. These flues pass upwards to the attic, where they are gathered into a single galvanized iron flue which passes to the centre of the building, where it enters a perpendicular shaft in which is an accelerating steam coil. This arrangement is indicated in the sections Figs. 1 and 2, Plate 15.

The south pay ward is devoted exclusively to females, and the north one to males. In the female pay ward the large central room on the west front of the second story is fitted up as an operating room, with tiled floor, sinks, wash basins, etc.

An exterior view of the male pay ward, taken from the northeast, is given in Plate 1.

These buildings are finished in ash, have an electric bell for each room, and are handsomely furnished. Each bed has over it an iron crane or swinging bracket, from which is suspended a strong leather strap, by means of which the patient can assist himself to turn or rise in bed. (See Fig. 1, Page 86.) An interior view

of one of these private rooms, showing style of furniture and one of the cranes above referred to, is shown in Plate 16.

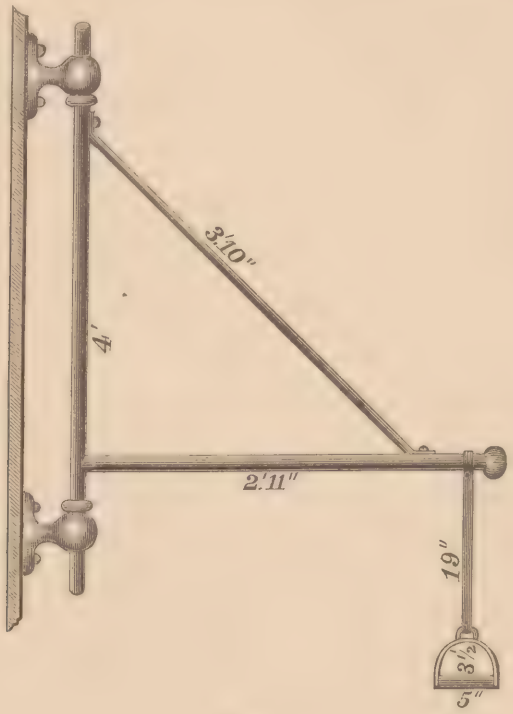

Fig. 1.

The Common Wards.

The three common wards are almost precisely alike, so that a description of one will serve for all, the chief difference being that the basement of the one nearest the octagon ward is connected by a covered corridor with the amphitheatre, as shown on the block plan, Plate 2. The plan of the main, or ward, floor of a common ward is shown in Fig. 1, Plate 21.

The main ward is a room 99 feet 6 inches long, 27 feet 6 inches wide, 15 feet high at the side walls, and 16 feet high in the clear in the centre, and is intended to contain twenty-four beds, as shown

on the plan, giving to each bed 7′ 6″ of wall space, 106.9 square feet of floor area, and 1768.9 cubic feet of air space.

At the south end of the ward is a large bay window, the sash of which comes nearly to the floor, forming a sort of sun room, and in the floor near the walls and windows of this bay are laid iron plates, covering an iron box, in which run hot-water pipes, thus giving a warm floor, to prevent the downflow of air chilled by the window surface, and thus to ensure warm feet and comfort to the convalescents sitting in this space in cold weather. Right angles in the ward are avoided as far as possible, all corners are rounded, the junction of the ceiling with the walls forms a quarter circle, and the same occurs at the junction of the walls and floor, this last being effected, as shown in Fig. 6, Plate 23, by the use of a curved strip of hard wood instead of the ordinary washboard.

The most important feature of the ward is the method of heating and ventilation, which is arranged as follows:—The heating is effected by hot water coming from the mains in the pipe tunnel and passing through coils of 3-inch cast-iron pipe arranged in stacks in the basement against the outer walls, as shown in Fig. 1, Plate 22. Under ordinary circumstances, in cold weather, the average temperature in these coils is 150° F., but, as explained in the general description of heating and ventilation, the temperature in any coil, or set of coils, can be lowered to any degree above that of the external air by lessening the velocity of the current of hot water passing through it, which is readily effected by valves placed on the flow and return pipe of each coil.

The fresh air supply is admitted through openings in the exterior walls of the basement of the ward, coming from over the green lawn which surrounds the wards. This opening in the wall is pro-

tected by wire netting and communicates with a galvanized-iron flue which passes downward to open in the chamber beneath the heating coil, and also upward directly to the fresh air register in the ward. In this flue, opposite the external opening, is a cast-iron valve or damper operated from the ward above, by means of which the incoming fresh air can be either directed wholly downward, so that it must all pass through the heating coil, or wholly upward, so that it passes directly to the ward without being heated, or partly upward and partly downward, so as to produce a mixture of any desired temperature. This arrangement is indicated in the cross section of the ward, Fig. 3, Plate 21, and is also shown in detail in Fig. 2, Plate 23.

The lower end of the galvanized-iron fresh air flue which opens beneath the flue has a valve which can be closed to regulate the amount of incoming air, when this is necessary in cold and windy weather.

The heating coils are enclosed in brick chambers, which have at the top, in front of the coils, a large plate composed of two sheets of galvanized iron with felt between. These plates or doors fit tightly, but can be readily removed, thus giving the freest access to the pipes for the purposes of cleansing or of repair.

Two systems of exit flues are provided to remove fouled air from the ward. The first consists of a series of circular openings in the floor of the ward, one beneath the foot of each bed. These openings are 12 inches in diameter and are each covered with a nearly hemispherical dome of wire netting to prevent the dropping of small objects into the flues beneath. Each of these openings communicates with a galvanized-iron tube, 12 inches in diameter, which passes obliquely on the ceiling of the basement to enter the lower

foul air duct, which runs longitudinally beneath the ward floor to enter the ventilating chimney. These lower ducts are indicated in dotted outline in Fig. 1, Plate 21, and in Fig. 1, Plate 23. They also appear in the cross section Fig. 3, Plate 21.

The main longitudinal foul air duct is constructed of wood lined with galvanized-iron. At the end most remote from the chimney it measures internally 1′ 10″ × 1′ 3″, and from this point it gradually enlarges, to provide for the additional flues entering it, until at the point where it enters the ventilating chimney it measures internally 4′ 4″ × 2′ 10″. The ventilating chimney is 4′ 2″ in diameter and 75 feet high.

The upper system for the escape of foul air consists of six openings in the centre of the ceiling of the ward, each measuring 2′ × 2′ and placed 13 feet apart. These open into the upper foul air duct, which runs longitudinally in the attic above the ceiling of the ward and enters the ventilating chimney, corresponding to the lower duct just described. This upper foul air duct is shown in Fig. 2, Plate 22, being marked VW, and in the section Fig. 1, Plate 23. The ceiling of the ward is one foot higher in the centre than at the sides. The openings in the ceiling into the upper foul air duct are controlled by shutters, which are raised or lowered at pleasure by the movement of an iron lever in the ventilating chimney. In this main ventilating chimney or aspirating shaft, there is placed, just above the entrance of the upper longitudinal foul air duct, a coil of pipe, heated by high-pressure steam, which serves to increase the velocity of the upward current of air in the chimney, and is therefore called the accelerating coil.

Under ordinary circumstances, in cold weather, only the downward ventilation is used, as this tends to save heat; but whenever

the ward becomes overheated, or it is desired for any reason to pass a large quantity of air through it, the ceiling registers are also opened. In moderate and warm weather, both sets of registers are open. The velocity of the upward current in the ventilating chimney, and therefore its aspirating power, may be increased as above stated by means of the aspirating coil. It may also be regulated by a pair of valves near the top of the chimney, which can be closed or opened by an iron lever in the chimney, accessible through a small door just opposite the door of the ward. The plan and section of these valves is shown in Fig. 3, Plate 23.

In addition to these means for producing and regulating air currents, the common ward nearest the octagon is provided with a propelling fan, situated in the basement, at the south end. From this fan, which is run by steam power, and is four feet in diameter, a duct is led from which a branch is given off, which enters each coil chamber at the floor and turns upward for a short distance. This arrangement of fan and ducts is indicated on Fig. 1, Plate 22.

The diameter of the air duct as it leaves the fan case is four feet. It divides into two main branches each two feet square, and from these are given off the branch ducts to each coil, each being ten inches in diameter. By running this fan for a few moments a very large amount of air can be forced into the ward, securing a thorough aerial flushing, and the prompt removal of unpleasant odors. In hot, still weather the currents of air produced by the fan in the ward are very grateful to the sick. The other wards are fitted to receive similar fans and ducts, but are not yet supplied with them.

The whole system of ventilation, sizes of ducts, flues and registers, and provision of power to ensure movement of air, is

intended to secure one cubic foot of fresh air per second for each of the twenty-four beds in the room, and to provide a reserve capacity of doubling this supply if it be desired to do so. The capacity of the apparatus is in excess of this, as will be seen by the figures given in the general remarks on heating and ventilation, page 66, *supra*. In this connection it should be borne in mind that these wards are not intended for cases of contagious disease, nor for cases such as uterine cancer, etc., which give rise to very offensive odors.

Special care has been taken to keep the system of ventilation of the ward distinct from the air supply of all other rooms. The large doors at the north end of the ward are self-closing, and should never be blocked open, except in very warm weather when all the windows are up and the patients are as nearly out-of-doors as possible.

The methods of construction of the walls, floors, shutters, etc., of the ward are described in the general introduction, and need no special comment here. The mode of finish of the doors and windows is shown in Figs. 4 and 5, Plate 23.

Next to the ward at the north end are the nurses' closet, the bath-room, lavatory, and water-closets, while on the other side of the corridor are the tea kitchen, dining-room, two wards for one or two beds each, and clothing and linen closets. The nurse has no sleeping or sitting room in this building. The tea kitchen has a small gas stove, and a steam table. The clothing closet is for the clothing of the patients, each having a separate compartment with hooks, a place for shoes, etc. This room has a separate air supply and exit flue. In the nurses' closet is a drying closet heated by steam. The bath tub is movable, and can be raised on a truck and carried to any bedside, if desired.

The Octagon Ward.

The octagon ward is situated, as shown in the block plan, southeast of the kitchen, being the first ward reached in passing from the administration building. This form of ward was proposed by Mr. Niernsee as a modification of the nearly square ward with the central chimney, used in two pavilions of the Massachusetts General Hospital, and it was selected for this position mainly because in carrying out the corresponding row of buildings on the south side of the lot the ordinary rectangular ward would have come too close to the nurses' home. It differs from the other wards in having two stories, besides the usual basement for heating apparatus, etc. The diameter of this ward, measured from opposite faces, is 57 feet 8 inches; the length of each face on the inner surface is 23 feet 10 inches. The height at the centre against the central chimney is 16 feet, the height at the walls is 15 feet, the average wall area per bed is 120 square feet, the number of square feet of flooring area per bed is 114.9 square feet, and the number of cubic feet per bed is 1760.8. The cubic capacity of the whole ward, including the bay window, is 42,160.8 cubic feet.

In these wards the sun room at the south end is more nearly separated from the ward than it is in the common ward, forming a bay window with sash on five sides. The floor plans of this building are shown in Figures 1 and 2, Plate 17. The heating of the ward is arranged substantially as in the common ward, heretofore described, but the system of ventilation is altogether different. Rising through the centre of the ward is an octagonal brick chimney, 8 feet in diameter internally, and with walls two feet six inches thick, making a total external diameter of 13 feet. Upon each face of this chimney are two openings from the ward, one

near the floor, the other near the ceiling, each measuring 20″ by 26″. Those in the lower ward open directly into the central shaft.

Within this brick chimney is set a boiler-iron tube, 5 feet 9 inches in diameter, resting on a projecting cast-iron base built into the walls, which tube extends from the floor of the lower ward to above the ceiling of the upper one. Into the space between this boiler-iron flue and the outer chimney the openings from the upper ward enter. Just above the top of the boiler-iron flue is placed a ring of steam pipe to act as an accelerating coil. Through the centre of the chimney rises a cast-iron pipe 12 inches in diameter, which is intended to serve as a smoke flue for the open fireplaces to be placed in the wards against the central chimney, if these are found to be desirable.

This smoke flue extends to the basement floor, where a large opening into it is provided to permit of the removal of soot swept down. Above, the smoke flue extends through and projects a little above the fixed cowl which caps the top of the chimney.

In these wards the general direction of the air currents is from the circumference towards the central shaft. In cold weather the air passes either entirely or in part through the heating coils, the temperature being regulated by a valve as described for the common wards, and is allowed to escape during the greater part of the time through the openings near the floor in the central shaft, in order to secure uniform diffusion of the fresh air and to prevent undue loss of heat. During warm weather, or when it is desired to rapidly change the air of the ward, the upper registers in the central shaft near the ceiling are opened, in addition to the lower ones. The general arrangement of the central shaft is shown in the longitudinal section of the ward, Fig. 1, Plate 18, which also indicates

by dotted lines the position and course of the hot air flues in the piers between the windows in the external walls. The area of clear opening at the top of the central shaft can be diminished by valves, a section and plan of which are given in Figs. 3 and 4, Plate 18.

The service rooms, private wards, etc., on each floor of this building are substantially the same as in the common wards, and are shown on the plan, the exit ventilating flues being indicated on the section.

An interior view of one of the octagon wards is shown in Plate 19, the view being taken from the north, or corridor, end of the ward. An exterior view of the building from the southeast is shown in Plate 20.

The Isolating Ward.

This ward is situated at the extreme east end of the north corridor, as shown on the block plan. It is a one-story building with a basement, the arrangement of the rooms in which is shown in Fig. 1, Plate 26.

The essential feature of this ward is that the central corridor is freely open to the external air at either end, and rises through the building in a clere-story at the top, the sides of the clere-story being fitted with movable glass louvres.

The walls of this corridor are practically double, and it is necessary to pass through two doors to get from the corridor into one of the patients' rooms. Each room for a patient measures 11′ by 13′ 1″. It has an open fireplace with a separate chimney flue placed in the centre of the inner wall of the room. At one side of this chimney and fireplace is the entrance to the room from the corridor, consisting of a small vestibule with doors on each side, as above

described; on the other side of the chimney is a small closet, in which is a commode containing a chamber utensil, which can be removed through an opening in the wall, without the necessity of entering the patient's room for that purpose. This closet is lined with galvanized iron, and has a separate exit flue, in which is an accelerating steam coil. The door of this closet does not come quite to the floor, and the exit of foul air takes place mainly through this closet and up its special flue, which is of iron. The whole of this closet, with its exit flue, can readily be cleansed with flame. The object of this arrangement is that each patient taken to this ward shall not only be isolated from the rest of the Hospital, but also, as far as possible, from all other patients in the ward. There is no common water-closet or bath-room, and no risk that the air from one room may pass into another by means of the common corridor, since this last is practically an open air passage.

The peculiar arrangement of these ventilating closets, with their flues and accelerating steam coils, is shown in Figs. 1, 5 and 6 of Plate 27.

The iron pipe from the closet passes obliquely from a point just above the accelerating steam coil into the chimney flue leading from the open fireplace, and extends through this flue to the top of the chimney, as shown in Fig. 9, Plate 27. Fresh air enters these rooms through registers in the corner, in the outer wall; the arrangements for heating and regulating the temperature of the incoming air being substantially the same as those described for the common wards, but the amount of heating surface is greater, being calculated for a constant supply of air amounting to two cubic feet per second for each room.

The chamber utensils containing excreta, when removed from

the commodes, are taken to a special sink marked K on the plan, Fig. 1, Plate 26. This sink is enclosed by glass doors, has special ventilation and air supply, and the excreta can be thoroughly disinfected before being thrown into the sink. Three of the rooms marked I on the plan, Fig. 1, Plate 26, are larger than the others, measuring 13′ 1″ by 13′ 10″ each, and in these rooms the fresh incoming air, instead of entering through a register in the side wall, enters through the floor, which, for a distance of 7 feet from the outer wall, is perforated with ¼-inch holes, giving over 94 square feet of floor, having 50 holes to the square foot. These holes are slightly funnel-shaped, and 20 are estimated as equal to one square inch of clear inlet. There are 5000 such holes in each room.

The arrangement for heating purposes in these rooms is shown in Figs. 2, 3 and 4 of Plate 27. The object is to supply a large amount of air, about 4 cubic feet per second, to each inmate, and to have this air pass constantly upwards, so that no portion of this air shall be rebreathed or come a second time in contact with the patient, thus placing him in the condition of being out-of-doors in a very gentle current of air. The amount of heating surface in the coils for these rooms is, of course, much larger than for the other rooms, as will be seen by the table given in the general description of the heating and ventilation of the Hospital.

In order to secure as little communication as possible, between this ward and the rest of the Hospital, arrangements are provided that the nurses on duty in this building shall remain there for several days at a time, and, accordingly, two bedrooms are provided for nurses, each room containing two beds. The bath-room in this building is mounted on a truck, and can be readily wheeled into any room where it is desired. The basement of this building

is entirely unoccupied, except by the heating and ventilating apparatus.

An exterior view of the isolating ward, as seen from the northeast, is given in Plate 28.

The Kitchen Building.

This is a square building measuring 75 feet on each side, and three stories in height, with a cellar, situated on Monument Street, in the rear of the male pay ward, and at the north end of the corridor which extends between it and the nurses' home, as shown on the block plan, Plate 2.

The main floor of this building is shown in Fig. 1, Plate 29. It is on a level with the floor of the corridor into which it opens on the south. The two cold rooms (see Fig. 2, Plate 30), or refrigerators, on this floor are built with hollow walls formed by placing thick paper on the brick walls, then 1½-inch battens covered by a ⅞-inch lining of poplar boards. Over this is another layer of paper, another layer of battens, and another layer of ⅞ poplar sheathing, thus giving two spaces 1½ inches in width, to prevent the conduction of heat. In the smaller of these cold rooms a lining of galvanized iron is laid over the inner poplar sheathing.

The kitchen fixtures in the kitchen itself are indicated on the plan. The range is a double table range, to which there is free access on all sides, and has over it a large hood to lead the fumes or vapors into the central chimney. The kitchen fixtures are those ordinarily used in large and well-appointed hotel kitchens, and were supplied by Bramhall, Deane & Co., of N. Y. The food is delivered from the kitchen through openings into the central hall to attendants, who place the vessels containing it on small trucks, by which

it is conveyed through the corridor to the several buildings. All the ordinary ward diets are furnished from this kitchen, as well as the food for all the officers and servants of the Hospital. The arrangement of the truck and the plan of the food cases for conveying food from the kitchen to the wards are shown in Figs. 2, 3.

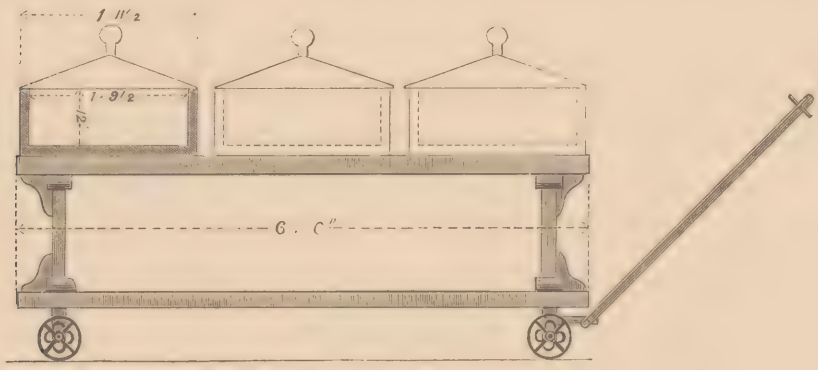

Fig. 2.

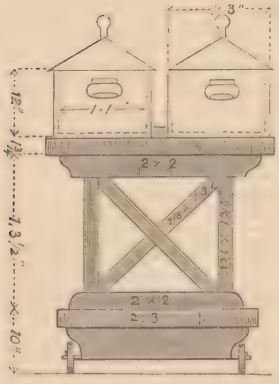

Fig. 3.

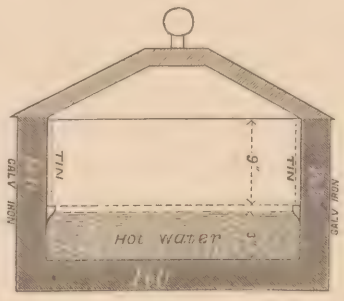

Fig. 4.

4. The food cases themselves are double boxes, the outside being of galvanized iron, and the inside of tin. They measure 24 × 16 inches and are 12 inches deep. The space between the galvanized-iron and tin is about one inch, and is filled with hair felt. Hot

water is poured in the bottom of the cases, and the dishes containing the food rest on cleats or ledges above the hot water, as shown in Fig. 4. The truck for conveying these cases is six feet long and two feet three inches wide, and has one platform 9 inches from the floor and an upper platform, as shown in Fig. 2. By the use of these cases the food is readily conveyed to considerable distances without losing heat.

The second floor plan of the kitchen is shown in Fig. 2, Plate 29. It contains rooms for the housekeeper and cooks, and dining rooms for the servants and employes of the hospital.

The plan of the basement floor of this building is shown in Plate 30. It contains the bakery, the bread store-room, the pastry cook's kitchen store-rooms, and a cold room similar in arrangement to that described on the preceding floor.

The boiler vaults are shown in Plate 34.

Sections of the building, from north to south and from east to west, are given in Plates 31 and 32.

The description of the arrangements of pipes, expansion joints, water filter, etc., shown in Plate 32 will be found under the general headings heating and ventilation, and water supply.

It will be observed that the large central chimney into which the smoke flues from the boilers below enter, as shown in Fig. 1, Plate 31, does not receive the smoke and ventilating flues from the bakery, kitchen, etc., until these have passed above the attic floor. The arrangement of these flues outside the central flues is shown in Fig. 4, Plate 31.

The object of this arrangement is to prevent any irregularities of draft in the fires of the kitchen and bakery, by reason of variations of temperature in the large central chimney flue, according to whether all the boilers or only a portion of them are being fired.

The plan of the cellar floor is shown in Plate 34. On the north this cellar connects by the central passage with the boiler and coal vaults, which extend between the building and Monument Street, a part of the coal vaults being beneath the sidewalks, with openings above in the pavement, indicated by small dotted squares on the plan. Through these openings the coal can be dropped from the carts directly into the vaults below. These vaults have a storage capacity for about 500 tons of coal.

The boilers are situated entirely outside the wall of the kitchen building itself, and their smoke flues pass on the floor of the cellar, as indicated by the dotted lines, to the large chimney which rises through the centre of the building. These boilers, with their connections, have been described in the preliminary section headed heating and ventilation, see page 66.

Over the smoke flues of both the steam and hot-water boilers is built a platform raised 5 steps or 3′ 10″ above the level of the cellar floor, and the general return main for hot water passes beneath this platform on its way back to the boilers lying directly under the flow main which is indicated on the plan.

The rooms marked on the plan E. L. P. are for the electric light plant, including engines, dynamos, etc., when it is thought best to provide these.

The entire building is surrounded by an area the bottom of which is on the level of the floor of the boiler vaults—viz.: 86 feet above mean tide. On the west side this area forms a covered passage leading to the fuel lift, situated on the north side of the branch corridor leading to the male pay ward, and shown on the block plan. By this passage and lift all the fuel used in the open fireplaces in the wards, administration and apothecary's buildings is

conveyed. On the south side of the kitchen building this covered area opens into the pipe tunnel.

The top of the boiler vaults is on a level with the pavement of the sidewalk on Monument Street. The space between the boilers and coal vaults has a glass roof and an arrangement of openings to permit free circulation of air, as shown in section Fig. 1, Plate 34. All drainage from the boiler vaults and areas surrounding the kitchen passes to the two draining wells shown on the block plan between the kitchen and amphitheatre.

The Nurses' Home.

The nurses' home is situated at the south end of the north and south corridor, southeast of the female pay ward, as shown on the block plan, and is a square building measuring 90 feet on each side, four stories in height above the cellar, with a central clerestory. In the centre of the building is a ventilating chimney, within which is the brick smokestack of the boilers in the cellar. This chimney is square, measuring 6 feet 3 inches on each side internally, and having walls 2 feet thick. The thickness of the walls of the internal circular brick stack is 9 inches. The inside diameter of the circular smokestack is 4 feet, the outside diameter 5 feet 6 inches, thus giving 15.3 square feet of clear area for ventilating purposes between the chimney and the stack.

The cellar of this building contains hot-water boilers, fuel vaults and store rooms. The coal vaults extend beneath the sidewalk on Jefferson Street, the arrangement being substantially the same as that described for the coal vaults at the kitchen building, and the level of the hot-water boilers is precisely the same as that of those in the boiler vaults connected with the kitchen. The coal

vaults will hold about 150 tons of coal. The plan of the basement floor is shown in Plate 36. It contains the nurses' dining room, the training kitchen, a large pantry, a lecture room, sewing rooms and store rooms.

The arrangement of the main floor plan is shown in Plate 37. This is on the level of the corridor floor, and contains a large main hall, the nurses' parlor and library, apartments for the superintendent of nurses, rooms for head nurses, etc. The two upper floors are the same in plan, as shown in Figure 1, Plate 38, and contain rooms for nurses.

It will be seen from the plans and sections of this building that its general arrangement is that of a square central tower surrounded by corridors on all sides, with an external shell of living rooms. The central tower contains the large ventilating chimney, the stairway, and the water closets and bath rooms. In the outer shell on the upper floor each nurse has a room to herself. All water pipes and soil pipes are in the central tower, there being no fixed basins in the living rooms. Two large shafts for air and light are carried up through the central tower, as shown in the plans. These shafts communicate freely with the outer air both above and below, so that they have little tendency to act as aspirating shafts, and from them is taken the air supply for the adjacent closets. The building is heated by hot water, the radiating coils being in the cellar for all living rooms. The outlet air flows from the rooms on the basement floor from openings on the inner walls into flues which run downwards and then horizontally, being suspended from the ceiling of the cellar, and enters the space in the central ventilating chimney between its inner surface and the outer surface of the central smokestack.

The ventilating flues from the living rooms on the upper floors pass upwards in the inner walls of those rooms to the attic, where they unite in large galvanized-iron flues, which enter the central chimney, as shown in the section Plate 40. On each of the upper floors are four rooms provided with fireplaces and electric call bells, as shown in the plan in Plate 38. These are intended especially for the use of nurses who may be sick. The ventilation from the water closets passes directly into the central shaft, as shown in the section Plate 39. The main floor of the nurses' home is separated from the covered corridor which unites the wards by an interval of 24 feet 3 inches, which forms a "fresh air cut-off" in summer, so that the corridor air cannot enter the home. In winter this is an enclosed passage. On the cellar and basement floors there is communication with the pipe tunnel, through which pass the hot water flow and return pipes, as shown in the section Plate 39. By means of a lift at the south end of the corridor, as shown on the basement and main floor plans, food can be brought to this building from the main kitchen without being exposed to the outer air. With these exceptions the nurses' home is an entirely independent building, having the general character of a well-finished hotel of medium size, in which each occupant has a front room well lighted and separately ventilated. The external view of the nurses' home, as seen from the northeast, is given in Plate 41. The interior view of the main hall in this building on the main floor, as seen from the terrace over the pipe tunnel, is given in Plate 42. The interior view of the parlor of the nurses' home, as seen from the south end looking towards the north, is given in Plate 43.

Amphitheatre and Dispensary.

These buildings, joined by a connecting corridor through which is a narrow open air passage, forming a fresh air cut-off, are situated on the north side of the grounds, opposite the three common wards, as shown on the block plan, Plate 2.

The amphitheatre is a one-story building with a cellar, measuring 91×75 feet, and is connected with the basement of the administrative portion of the first common ward by an enclosed corridor, as shown on the block plan. The arrangement of the rooms in this building is shown on the plan Fig. 1, Plate 48. It contains the large amphitheatre, measuring 52×47 feet, with seating capacity for about 280 persons, a special operating room measuring 18×26 feet 6 inches, well lighted from the south and by a large bay window on the east, an etherizing room, recovering room, a surgeon's room, a small special ward for three beds, and the accident reception room, containing two beds. There is an entrance to the amphitheatre from Monument Street, for the use of students.

The heating of the amphitheatre is effected by steam coils placed in the space below the seats, the fresh warm air entering through the risers. The foul air is drawn off into the ventilating chimney 6 feet square, which is in the centre of the south side of the building. The air may be taken into this chimney either below near the floor, or above near the ceiling. The arrangement for this is shown in section Fig. 2, Plate 48.

The seats and backs of seats in the amphitheatre are made of three thin layers of birch wood, glued together and perforated with numerous holes, resting upon iron brackets, the fronts and caps being of cherry.

This amphitheatre is lighted by a large skylight, and also by a

large window on the north side. Each set of seats rises a little higher than the one just below it, so that a line drawn on the top of the backs of the seats from above downwards forms a curve, the concavity being upwards, which arrangement is deemed best in order to secure a good view for the occupants of each tier of seats.

Opening from the amphitheatre by the side of the ventilating chimney is a dark room, marked D on the plan Fig. 1, Plate 48. This room is intended for use in developing negatives which may be taken by photography in the amphitheatre itself.

The special ward is intended for those cases which it is not considered desirable to take back into the wards for several days after an operation. An interior view of the amphitheatre is given in Plate 49.

The dispensary, situated east of the amphitheatre and connected with it by a covered corridor, as above described, is a brick building of one story with a cellar, measuring 91′×75′.

The arrangement of the rooms is shown in Fig. 1, Plate 46. It contains a large central waiting room 52 feet square, on the east and west sides of which are the rooms for the physicians, surgeons and specialists who have charge of this service.

It is heated by steam coils in the cellar, the fresh warm air being delivered through the risers and backs of the benches, as shown in sections Figs. 3 and 4, Plate 46. The temperature of this air can be regulated without diminishing the quantity by the use of the valves, as shown in Fig. 4, Plate 46. The extraction of the foul air from the dispensary is effected by a large ventilating shaft on the south of the general waiting room, this shaft being six feet square internally. The air may enter this shaft either through a

large opening near the floor level, or through a large duct which communicates with the skylight, and its flow is made constant by means of an accelerating steam coil placed just above the upper opening.

The general waiting room is lighted by a large central skylight, the other rooms by side windows.

Medicines are dispensed from the pharmacy, which is on the south side of the waiting room. The general waiting room has a seating capacity for 400 patients. An interior view of the waiting room and dispensary is given in Plate 47, the view being from the north door, looking towards the pharmacy on the south. An exterior view of the amphitheatre and dispensary, as seen from the north, is given in Plate 50.

The Pathological Building.

The pathological building is situated on the northeast corner of the Hospital grounds, as shown on the block Plate 2, and is not connected by corridors with any other building. It contains a morgue or room for the dead, a waiting room for friends of the dead, an autopsy theatre, and a number of rooms intended for the use of the professional staff of the Hospital in pathological and bacteriological studies. For the present the building is also used as the pathological laboratory of the University.

It is a two-story building, with attic and cellar, measuring 58×78 feet. The general arrangement of the rooms is shown in Figs. 1 and 2, Plate 51. On the lower or ground floor is the morgue, the waiting room, the autopsy theatre, a room for those engaged in private research, and rooms for bacteriological work. On the second floor is the director's laboratory, a laboratory for

pathological histology, one for experimental pathology, a pathological museum, and photograph rooms.

The morgue measures 17′ by 29′ 8″. It is not heated, and is ventilated so that no communication exists between the air of this and of other rooms in the building. The floor is asphalt. The room is provided with running water, a sink, a refrigerator, and with zinc-covered tables and undertaker's ice caskets for the reception of dead bodies.

The autopsy theatre measures 29′ 8″ by 38′ 2″, and extends through both stories of the building. This room is lighted by a skylight and by east windows. The theatre is arranged so that the observers stand upon elevated tiers arranged semi-circularly around the autopsy table. The first row of standing places is 3′ 6″ above the floor, the second is 1′ 5″ above the first, and in passing upward the elevation of each tier from the next lower one progressively increases by from 1 to 3 inches. The width of each tier is 1′ 10″. In front of each tier is a railing 3′ 3″ high. The arrangement is such that the observers are brought as close to the autopsy table as possible, and can look down readily over the heads and shoulders of those below. There is accommodation for from 60 to 70 observers on these tiers. Against the wall, back of the autopsy table, is a large table the top of which consists of a heavy piece of slate 7′ 8″ long by 2′ 6″ broad. Beneath this are cupboards for specimen-trays. By means of a movable crane 9′ 6″ from the floor and projecting forward from the wall 9′ 10″, running water is brought over the autopsy table. The room contains a large sink with three stop-cocks for running water and a drainage tray. There are drawers and cupboards for instruments, specimens, etc. The floor is of asphalt. The room is ventilated by one of the two ventilating

shafts, 3′ by 3′ 6″, which are shown on the plan. There is an arrangement by which the autopsy table can be ventilated downward through a tube opening in its centre.

The bacteriological rooms occupy the northern side of the building. An interior view of one of these rooms is shown in Plate 53. A table attached to the wall and supported by brackets runs along the entire northern side of the room in front of the windows. The top of this table is 2 feet 10½ inches from the floor, and is 2 feet 6 inches broad. Stools with stuffed leather seats, which can be raised or lowered by a revolving screw, are used by those working at this table. Cases 3 feet 3 inches high and 1 foot deep, with open fronts, and containing shelves for culture tubes, re-agents, specimens, etc., are attached to the wall in front of this working table between the windows. At the side of each working place is a drawer beneath the top of the table, these drawers being absent from the part of the table which comes in front of a window. Along the middle of the room are two stationary tables 8 feet long, 4 feet broad, and 2 feet 6 inches high. At one end of each table is a tap for hot and for cold running water, and in the centre of the table are four gas-jets. There is a single horizontal row of six drawers beneath the top on each of the long sides of the table, and beneath these drawers the rest of the space on each side is occupied by three cupboards with a shelf running along the sides and back of each cupboard, leaving the central space free to receive high objects. Each cupboard is provided with double doors, which can be secured by a Yale lock.

Against the side of the room, opposite the windows, is placed a hood, where three steam sterilizers can be accommodated. Next to this is a cremation furnace enclosed in an iron hood. This fur-

nace, in which small animals and rubbish can be consumed, is constructed on the principle adopted for some of the furnaces employed to consume garbage. The enclosing hood prevents much heat from escaping into the room from the furnace when in use.

Against the eastern wall of the room (not shown in the photograph) are two hot-air sterilizers protected by asbestos. In this part of the room is also a large sink with drainage tray. The room contains, in addition, tables and cases with shelves, drawers and cupboards. A small room opening into the main room at its northeastern corner contains the thermostats.

The smaller bacteriological room at the northwestern part of the building, a part of which is shown in the photograph, opens into the larger room, and is furnished in a similar manner. The floor of both rooms is of asphalt, and can be flushed with water.

The two rooms on the north side of the second story (17 feet 2 inches by 37 feet, and 17 feet 2 inches by 17 feet) are devoted to pathological histology. A table similar to that in the bacteriological rooms is attached to the sides in which there are windows. Over this table, attached to the wall, are cases 4 feet long, 2 feet 10 inches high, and $12\frac{1}{2}$ inches deep. These are divided into four compartments or cupboards, two above and two below, each with a glass door provided with a Yale lock. A shelf, $4\frac{1}{2}$ inches broad, runs around the sides and back of each cupboard. In these cupboards can be placed and locked up the microscopes, microscopical specimens, re-agents and instruments of those working at the table. Other fittings of these histological rooms are a hood, cases with shelves, drawers and cupboards, sinks and drainage boards, blackboard, tables, cases for microscopical specimens, etc. A small room or closet opening into the main histological room is lined with

shelves, where are kept hardened specimens for microscopical study.

Room E P, of Fig. 2, Plate 51, in the southeast corner of the building, is used for experimental pathology. This is fitted with a hood, sink, tables, cases with shelves, drawers, cupboards, tables for operating on animals, etc. Here are also an injecting apparatus, a Ludwig's kymographion, electrical apparatus, manometers, and other instruments for experimental investigations. Dawson's rabbit and dog-holders are customarily used in preference to Czermak's, Bernard's, or other forms.

The photographic room is fitted with shutters, so that it can serve as a dark camera, or it can also receive light from a window. On the southern front of this room is a balcony, to which there is access from the experimental room. From this balcony a heliostat can be arranged upon a shelf attached to one of the shutters, and through a hole in the shutter the sunlight can be reflected to the object to be photographed. A dark closet is connected with this room.

The museum is provided with cases with shelves around the sides and also projecting from the western wall into the interior.

The basement or cellar is divided into a number of rooms lighted by windows. In one of these is placed the furnace, the building being heated by the outside air passing over steam coils. The northwest room in the cellar contains the thermostats kept at the proper temperature for gelatine cultures. Partitioned off from this room is a small room or closet 10′ long by 5′ 6″ broad, the walls of which are composed largely of glass. These walls have been constructed with care, so that dust cannot enter from without, and here, when deemed necessary, cultures can be prepared and other

manipulations performed where accidental infection from the air is feared. Experience, however, has shown that such precautions as were contemplated in the construction of this room are unnecessary.

The southwest room in the basement is fitted with a carpenter's bench and tools.

The southeast room in the basement is at present used for keeping animals. For this purpose especial provisions have been made for the lighting, heating and ventilation of this room, so that the animals may be under favorable hygienic surroundings. The ventilation is so arranged that air from the animal room cannot gain access to other rooms in the building. The general arrangement of this room is shown in Fig. 5 (page 112).

All of the cages for keeping animals are constructed of galvanized-iron, the sides and tops being of galvanized-iron netting. The larger ones can all be taken apart and sterilized; the smaller ones are of a size which admits placing the whole cage in a large steam sterilizer. The accompanying drawings illustrate the construction of the cages used for inoculated rabbits and guinea pigs. The rabbit cages, Fig. 6 (page 113), are 13 inches long, 9 inches high, and 11 inches deep. The top and bottom of the cage can be lifted back on hinges. In front is a rack to receive a card containing the data concerning the inoculation. On the top is a handle permitting the ready transportation of the cage. The cages intended for inoculated guinea pigs, Fig. 7 (page 113), measure $10\frac{1}{2}$ inches long, $6\frac{1}{4}$ inches high, and $7\frac{1}{4}$ inches deep, and are made as shown in the drawing.

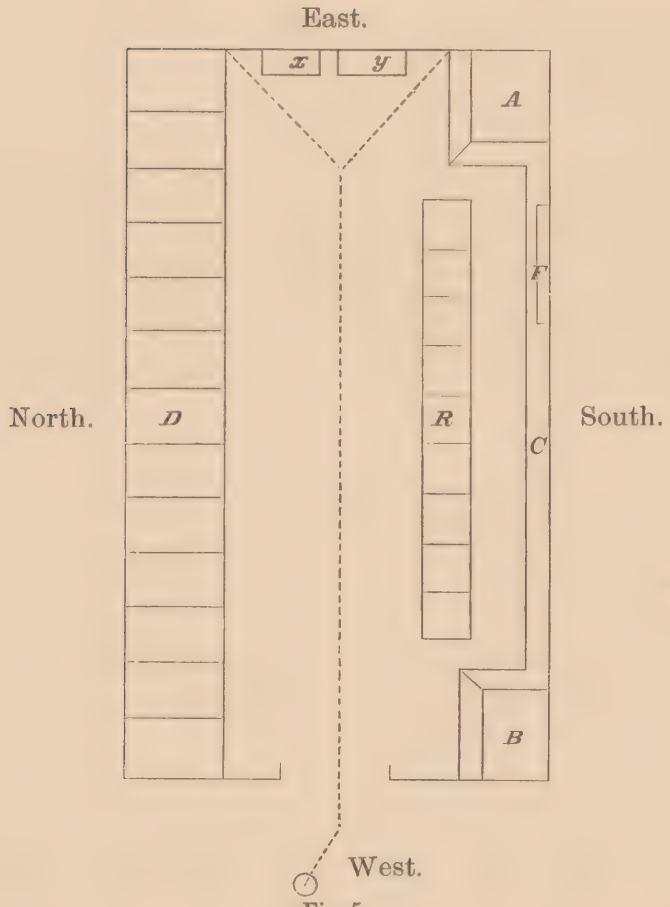

Fig. 5.

PLAN OF ANIMAL ROOM IN PATHOLOGICAL BUILDING.

A Flue in S. E. corner, 3′ 8″×3′ 3″.
B " " S. W. " 3′ 8″×2′ 6″.
C Shelf 1 foot wide. For small hand cages.
D Dog kennels. Frontage of each cage 2′ 4″, depth 4′, height 3′.
Dotted lines represent gutters draining into drain-well opposite door.
R Rabbit cages represented in Fig. 8.
X Sink for frogs.
Y Hot and cold water sink.
Room measures:
East and west, 30′ 2″.
North and south, 17′ 5½″.
Height, 9′ 9″.
Air space of room, 4847.6 cu. ft.
Floor falls 6 inches east to west and 3 inches from either side to central gutter.

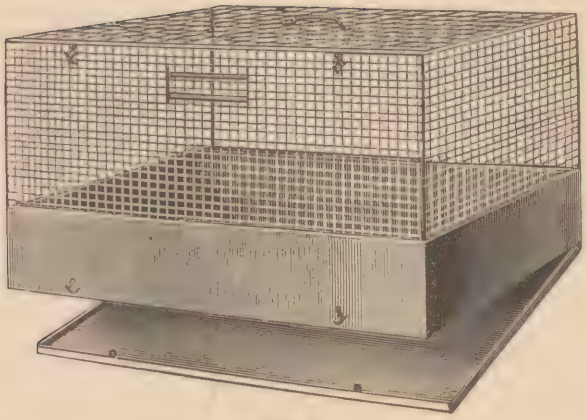

Fig. 6.

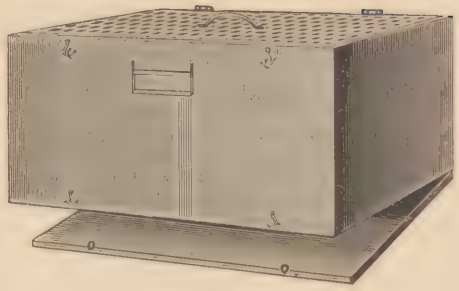

Fig. 7.

Fig. 8 (page 114) shows a drawing of a cage intended for rabbits or a small dog. It is 2 feet high, 2 feet deep, and 1½ feet broad. The door measures 11 × 14 inches. The floor slants, and is provided with gutters, so that the fluid discharges run through an opening in front into a cup. This cage can be taken apart and sterilized by steam.

The cage represented in Fig. 9 (page 114) is intended for the confinement of dogs. It forms one of a series of twelve which are arranged along the north side of the room as shown in the ground plan drawing (Fig. 5). In size it is 4′ deep, 3′ high, with a frontage varying from 2′ 4″ to 3′, with a door one foot wide extending the entire height of the front elevation. On the front of each cage, as in the case of the smaller ones, is a metallic rack for cards containing records of the experiment. These twelve cages are joined together by a stationary framework of iron which is fastened into the walls at its ends and at intervals, corresponding to the lateral boundary of each apartment, is supported by a double iron upright. This form of upright support serves also as a guide into which to slip the movable partitions between the apartments. The partition is represented in the solid sides of Fig. 9.

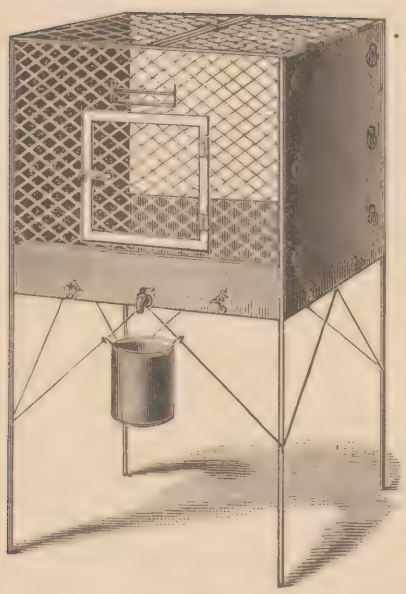

Fig. 8.

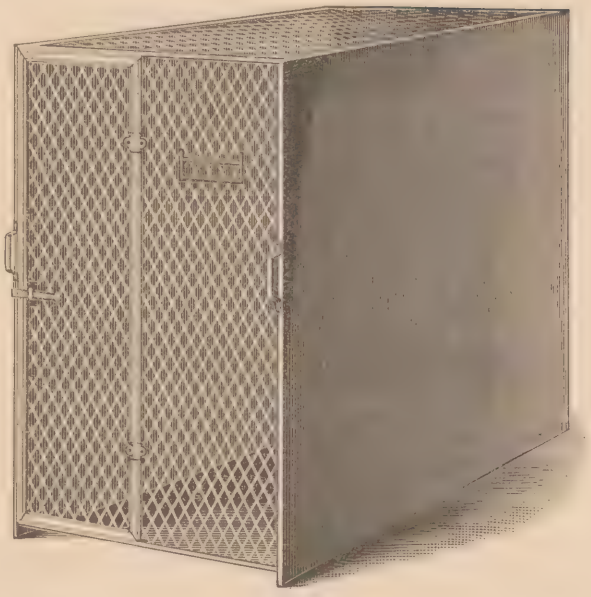

Fig. 9.

The object of the movable partition is to admit of the enlargement of an apartment if it is found necessary. By this arrangement the whole series may be converted into one large cage. These cages rest directly upon the asphalt pavement of the room, there being no separate bottom for them. As the pavement slopes toward the centre from the sides, the whole may easily be washed out with the hose. The cages are constructed of stout galvanized 1″ iron meshing. The joints are held together by bolts and nuts, in order that there may be no difficulty in taking them apart for sterilization.

The Laundry.

The laundry is situated on the southeast corner of the Hospital grounds, at a point most remote from the buildings now erected, as shown on the block plan, Plate 2. It is a brick building, measuring externally 115 by 56 feet, and is one story high, with a basement cellar. The general arrangement of the rooms on the basement

and main floor plans is shown in Figs. 1 and 2, Plate 54. The basement contains steam boilers, storage for coal, the engine, and the disinfecting chambers. These last consist of two rooms so arranged that the clothing or other articles to be disinfected, when taken into one of these rooms, pass thence into the disinfecting oven or boiler, from which they are removed on the other side, in another entirely separate room, so that the articles which have been cleansed and disinfected are not again exposed to infection while in the building.

The disinfecting chamber, of which a perspective view is given in Fig. 3, Plate 55, is made of boiler iron and has a double shell, into the space between which steam may be forced. It is also arranged for the admission of live steam into the interior of the chamber. It is of an elliptical section, the longer diameter being perpendicular, and is 7′ 2″ long, 7′ 5″ high, and 5′ 4″ wide. It is lined with wood, and has wooden forms on which the mattresses, clothing, etc., to be disinfected, may be hung or placed. There is also placed in the wall between the chamber which receives infected articles and that in which cleansed articles are delivered, a large iron kettle or caldron 3′ 3″ in diameter, with a capacity of 90 gallons. This is a double-jacketed boiler, heated by steam, and has two hemi-spherical covers, one opening into the outer, and one into the inner room. In this articles of clothing or bedding of small quantity can be steamed or boiled, thus avoiding the necessity of heating up the large disinfecting chamber when but few articles are to be treated.

The main floor of the laundry contains rooms for the washing and drying of the bedding and clothing from the patients which are distinct from those used for the officers and employees. The washing machines used are the Hamilton E. Smith's No. 3 Metallic

Washers. Two 26-inch centrifugal wringers and one 30-inch French mangle, are employed. The vapor from the washing machines is carried off through copper pipes, 4 inches in diameter, into a ventilating shaft. The tubs for hand washing are of porcelain. The top of the laundry has a flat roof, and is provided with lines for exposing the clothes to the fresh air and sunshine whenever the weather will permit, a steam lift being at hand for conveying the wash to and from the roof. The building has a separate water supply, with a filter. The cellar affords storage for 100 tons of coal.

The Bath House.

The bath house is situated in the southwest angle of the intersection of the main north and south corridor and the corridor leading to the male pay ward, as shown on the block plan, Plate 2. It is a one-story building with a basement, and measures 64′ 9″ by 31′ 3″, the long axis running north and south.

The arrangement of the rooms on the main floor is shown in Fig. 1, Plate 56. It contains rooms for hot air and for steam baths, with dressing rooms, and rooms for mercurial and sulphur baths. The entrance to this floor is from the corridor, the floor of which is on the same level.

The plan of the basement floor is shown in Fig. 2, Plate 56, and sections of the building are given in Figs. 3 and 4 of the same plate. This building is heated by steam and ventilated by a central chimney four feet square, in which is placed an accelerating steam coil, as shown in the sections Figs. 3 and 4, Plate 56. The floors of this building are of granolithic pavement, and the walls have a soap-stone finish.

Description of the Johns Hopkins Hospital.
Billings.
1890.
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Bethesda, MD

Condition on Receipt: The quarter cloth and decorated paper case binding was in good condition. The sewing was intact but a few of the pages were loose. Most of the pages were in relatively sound condition even though some had a few small tears and some losses.

Treatment Report: The pH was recorded before and after treatment; before 5.0, after 8.0. The volume was collated and disbound. The inks were tested for solubility. The head, tail, and pages were dry cleaned and nonaqueously buffered (deacidified) with a suspension of magnesium oxide particles in a perfluoro compound. The pages were encapsulated in polyester film. The volume was post bound in two full cloth bindings. A leather label was stamped in gold foil. The book plates were removed from the original binding and were adhered to the front pastedowns of the new bindings.

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